JOURNAL OF FINANCIAL INTERMEDIATION 3, 327–354 (1994)

Public versus Private Borrowing: A Theory with Implications for Bankruptcy Reform*

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Received December 21, 1992

A model is presented in which firms optimally finance investment with both public and private debt. The two instruments are perfect substitutes, except that private debt can easily be renegotiated in insolvency states while public debt cannot. The option to renegotiate is beneficial *ex post*, as it allows the firm to avoid inefficient liquidation, but *ex ante* it may worsen asset substitution. The welfare effects of alternative bankruptcy regimes are then compared, taking into account that firms modify their financing decision in response to the regime change. Some suggestions for reforming Chapter 11 of the U.S. bankruptcy code are presented. *Journal of Economic Literature* Classification Numbers: G32, G33, K2. © 1994 Academic Press, Inc.

1. INTRODUCTION

In an important paper, Myers (1977) showed that highly indebted firms may forego socially efficient investment opportunities because creditors are the main beneficiaries of future cash flow. Thus, firms that are economically viable may be liquidated, and their going-concern value may be lost. These inefficiencies do not arise if creditors make concessions that restore incentives to invest (Haugen and Senbet, 1978). Several studies of corporate financial distress argue that coordination failures prevent efficient debt renegotiation when firms bargain with several small creditors, such as bondholders or suppliers, while renegotiation costs are small when creditors are few and sophisticated, as in the case of bank loans or private placements (Gilson *et al.*, 1990; White, 1989; Gertner and Scharfstein, 1991).

* I thank P. Garella and workshop participants at I.G.I.E.R. and Johns Hopkins for their comments. Two referees and an editor of this journal have also provided valuable suggestions. Part of this research was conducted while I was visiting I.G.I.E.R. I thank the Institute and Ing. C. Olivetti & C. for financial support.

1042-9573/94 $6.00

These observations raise the question of why companies use publicly traded debt, which is more expensive to renegotiate. Most of the work on debt in the optimal financial structure has focused on the role of banks as delegated monitors: costly monitoring can reduce agency problems by insuring a minimum level of managerial effort (Gorton and Haubrich, 1987), by allowing a better assessment of default probabilities (Diamond, 1991) or by preventing management from absconding with output in bankruptcy states (Seward, 1990). In these models, insolvency always results in the liquidation of the firm, and debt renegotiation does not occur. Gorton and Haubrich derive monitored loans and outside equity as optimal securities, but do not explain the role of privately placed debt. Diamond's model predicts that firms use either type of debt at different stages of their life cycle.[1] It is only in Seward's model that firms raise capital simultaneously through bank loans and privately placed debt. However, the distinction between the two securities (nonbank creditors do not verify output in bankruptcy states, while banks do) is somewhat artificial and calls for more explicit modeling of corporate financial distress. Also, Seward offers no predictions as to what empirically observable firm characteristics should be associated with the use of both types of loan.[2]

Perhaps the coexistence of private and public debt in corporate financial structures need not be explained by sophisticated models: small companies must exclusively rely on private debt because the fixed costs of issuing publicly traded securities are too large. On the other hand, for large companies public debt is cheaper than private debt, but bank monitoring is necessary to raise funds either from the bond market or from the market for commercial paper.[3] This theory is consistent with the empirical observation that publicly traded debt is a more important source of funds for large companies. For instance, Gertler and Gilchrist (1994) report that—on average—bank loans account for 68% of total debt for U.S. firms with assets below $50 million, but that they are only 17% of total debt for companies with assets exceeding $1 billion. However, while some very large corporations use bank lending (mainly in the form of unused credit lines), others rely almost exclusively on publicly traded

[1] Also, in Berlin and Loeys' (1988) model firms choose to borrow either through monitored loans or through nonmonitored debt depending on parameter values.

[2] In a recent paper, Rajan (1992) develops a model in which bank borrowing reduces agency costs because the bank, acquiring private information in a first round of lending, withdraws financing if the second-period project is unprofitable. *Ex ante*, however, a bank loan reduces managerial effort, because some of the second-period rents are captured by the informed bank. The optimal capital structure may include both monitored and arm's-length debt. However, the model implies that bank debt should have lower priority, which is counterfactual.

[3] I am indebted to a referee for suggesting this point.

debt.[4] This suggests that bank monitoring is not necessary for access to the bond market, and that firm size cannot explain all of the variation in the data. Finally, most bank loans are senior or even secured: as Gorton and Kahn (1992) observe, if the main purpose of borrowing from banks is to reassure bondholders that the debtor is being monitored, it should be optimal to make bank loans junior to publicly traded debt, or at least of equal priority.

This paper presents a model in which both public and private debt contracts play a role in the optimal financial structure because they have different renegotiation costs.[5] In the model, output is not verifiable; hence outside equity contracts are not feasible and outside financing must be raised through debt contracts. Debt, however, generates two types of agency cost: *ex post*, Myers' underinvestment problem arises unless liabilities can be perfectly renegotiated, while *ex ante* management can engage in asset substitution (Jensen and Meckling, 1976). The central insight is that shareholders' ability to renegotiate debt makes asset substitution especially attractive: in the standard model, incentives for excessive risk-taking arise because limited liability prevents equity's payoff from falling below zero in bad states of nature (Stiglitz, 1972).[6] Suppose now that in an adverse state creditors believe that the firm is worth more if it continues as a going concern in the hands of current owners. Then equity can bargain for concessions, and a debt forgiveness agreement is likely to be reached. Unless creditors have all the bargaining power, shareholders will capture some of the going-concern surplus, and their payoff in insolvency states will be strictly positive. As a result, incentives to undertake suboptimal risky projects increase. Issuing debt that is costly to renegotiate, such as public debt, can reduce equity's payoff in renegotiation states, limiting the extent of asset substitution. More specifically, in the model analyzed, there are parameter values for which first-best optimality (no asset substitution and no losses of going-concern surplus) can be achieved only if the firm borrows from both public and private sources. For other

[4] For instance, the following ratios of publicly traded debt to total long-term debt have been computed for selected U.S. companies from the 1993 Moody's Industrial Manual: Chrysler (96%), General Motors (100%), Mobil (100%), Motorola (97%), Xerox (98%), Woolworth (97%), Texas Instruments (98%), Philip Morris (98%), Rockwell (96%), and J. C. Penney (99%). Loan commitments and unused credit lines are included in total debt.

[5] If the obstacle to renegotiation is asymmetric information, monitoring may reduce renegotiation costs. However, work on financial distress suggests that the main obstacle to renegotiation is more likely to be the dispersion of the claimants. For instance, Detragiache (1992) shows that, when there is only one creditor but insiders have superior information, renegotiation is always efficient, provided that future output can be contractually allocated to outsiders.

[6] For the economic rationale of limited liability, see, for instance, Easterbrook and Fischel (1991).

parameter values, to avoid asset substitution, the firm must issue so much public debt that going-concern surplus is lost in some states of nature. In this case, equity must trade off the two costs *ex ante*. Finally, parameter values may also be such that asset substitution occurs for any choice of the financial structure.

The model is developed under the assumption that failure to reach a private debt workout leads to the liquidation of the debtor. This assumption is then relaxed, and the model is used to study the role of bankruptcy procedures that promote the reorganization of insolvent firms, such as Chapter 11 of the U.S. bankruptcy code. Reorganization laws are designed to reduce the impact of coordination failures among creditors. To this end, violations of creditor contractual rights are often allowed, albeit under the supervision of a bankruptcy judge. In the model, reorganization in bankruptcy allows the debtor to restructure the public debt, but it gives rise to deadweight court costs. This option changes the bargaining game played with private creditors in insolvency states and, ultimately, the choice of the optimal financial structure. In contrast to previous work (White, 1980, 1989; Gertner and Scharfstein, 1991), here the welfare effects of alternative bankruptcy laws are evaluated *ex ante*, taking into account that firms readjust their financial structure in response to the change in bankruptcy regime.

The first type of reorganization law considered stipulates that contractual priority must be respected in the settlement, so that shareholders receive a payment only if creditors are repaid in full. This rule approximately corresponds to the Absolute Priority Rule (APR) of the U.S. Bankruptcy Code (White, 1989). In this case, it is still optimal to borrow from both private and public creditors for some parameter values. Furthermore, if the deadweight costs of going to court are smaller than the going concern surplus, the new bankruptcy regime unambiguously improves welfare, otherwise, the effect is ambiguous: on the one hand, the first-best outcome, in which no asset substitution and no *ex post* inefficiencies occur in equilibrium, becomes more likely. On the other hand, inefficiencies are greater when parameters are such that out-of-court renegotiation fails and firms reorganize in court instead of liquidating.

The second reorganization regime analyzed is one in which contractual priority is violated in equity's favor. This regime resembles the current U.S. system: as several authors have pointed out, Chapter 11 gives considerable bargaining power to shareholders, who often obtain a positive payoff even if creditors are not fully satisfied (Bergman and Callen, 1991). Empirical studies by Weiss (1990), Eberhart *et al.* (1990), and Franks and Torous (1989) confirm this view. The welfare comparison shows that this regime is unambiguously dominated by the previous one in which contractual priority had to be respected in the settlement because the only effect of priority violations is to make asset substitution more attractive

for any given level of public debt. Hence, the ex ante commitment problem becomes more severe.

The concern with priority violations in Chapter 11 is not new: Bebchuck (1988) outlines a proposal to reform U.S. law to ensure enforcement of contractual priority. The scheme has the advantage that it does not require the judge to know the value of the firm. Also Aghion *et al.* (1993) recommend a similar procedure for Eastern European countries. The analysis conducted in this paper makes explicit the welfare gains that a reform along these lines could yield.

The paper is organized as follows. The basic model with no reorganization law is laid out in Section 2, and the choice of the optimal capital structure is derived. In Section 3 the effects of introducing a reorganization law are examined. The case in which contractual priorities are respected in the court settlement is contrasted with the more realistic case, in which priority violations take place. Some extensions of the model are discussed in Section 4. In Section 5, possible ways for testing the empirical implications of the model are discussed. Section 6 concludes.

2. PRIVATE AND PUBLIC DEBT IN A SIMPLE MODEL

2.1. *The Basic Assumptions*

The model has three periods, denoted by $t = 1, 2, 3$. At dates 1 and 2, risk-neutral managers/owners (henceforth referred to as equity) make an investment and a financing decision. At the first date, they can choose between a safe and a risky project, both requiring the same initial investment I_1. The returns from investing are a function of the discrete random variable $\omega : [\omega_1, \omega_2, \omega_3] \rightarrow [0, 1]$. The realization of ω becomes known at date 2. Let $p_i \equiv \Pr[\omega = \omega_i]$ for $i = 1, 2, 3$. The safe project yields $r > 0$ in states ω_1 and ω_2 and zero in state ω_3, while the risky project yields $R > 0$ in state ω_1 and zero otherwise. Both projects are profitable, but the safe project yields a higher expected return:

Assumption 1. $(p_1 + p_2)\, r - I_1 > p_1 R - I_1 > 0$.

At $t = 2$ equity can liquidate the business. The liquidation value of the firm is denoted by L. Alternatively, equity can undertake a project that requires a new investment of I_2 and yields $C(\omega_i) + I_2$ with probability one at $t = 3$. Table I summarizes the cash flow from the projects available in the two periods.

The following assumption states that the firm is always viable in period 2, in the sense that its going-concern value exceeds the liquidation value.[7]

[7] Introducing states of nature in which the firm is not viable would not significantly change the results.

TABLE I
CASH FLOW FROM THE INVESTMENT PROJECTS

State of nature	Cash flow at $t = 2$		Cash flow at $t = 3$	
	Risky	Safe	Liquidation	Continuation
ω_1	R	r	L	$C(\omega_1) + I_2$
ω_2	0	r	L	$C(\omega_2) + I_2$
ω_3	0	0	L	$C(\omega_3) + I_2$

Assumption 2. $C(\omega_1) \geq C(\omega_2) \geq C(\omega_3) > L$.

At $t = 1$ the firm has no internal funds available for investment, so external financing must be used. Creditors are risk-neutral and their opportunity cost of funds is zero. Equity can consume any output that is not distributed to outside investors. The next two assumptions describe the environment in which financial contracting takes place.

Assumption 3. The realization of ω is observable to all parties, but it cannot be verified by outsiders to the firm.

Following Hart and Moore (1989) and Bolton and Scharfstein (1990), this assumption is used to rule out contracts contingent on the realization of project returns, such as outside equity. In Section 4.4, an extension of the model that includes outside equity is briefly discussed. Debt contracts give creditors the right to force the firm into bankruptcy if the contractual payment is not made. The value of the bankrupt firm at $t = 2$ is the liquidation value L. This assumption is realistic if three conditions hold: (i) after the firm is liquidated, equity cannot start a new business to undertake the second-period project; (ii) creditors cannot sell the firm as a going concern (or manage the firm themselves) without losing investment opportunities; (iii) the bankruptcy law does not include a procedure that promotes going concern restructuring. The first two conditions are assumed to hold throughout the paper, while the third condition is relaxed in Section 3.

Another consequence of Assumption 3 is to rule out debt contracts that specify a particular allocation of the going-concern surplus in case of default. The resultion of financial distress is therefore left to bargaining. Only one-period debt contracts are considered here (see Section 4.2 on long-term debt). The next assumption creates the potential for asset substitution:

Assumption 4. The choice of project is not observable by outsiders to the firm.

Debt can be private or public. Private debt (i.e., bank loans, private placements) is in the hands of a few sophisticated creditors, such as commercial banks or insurance companies, that can coordinate their actions fairly easily if financial distress occurs. In contrast, public debt (bonds, commercial paper, trade credit) is held by a multiplicity of small investors. From this point of view, syndicated bank loans should be considered public debt.

Assumption 5. Private debt can be costlessly renegotiated, while public debt cannot be renegotiated.

This assumption is standard in the literature on corporate financial distress (Bulow and Shoven, 1978; White, 1980, 1989). Recently, Gertner and Scharfstein (1991) have studied a model in which atomistic bondholders optimally choose to hold out when management attempts to restructure debt through an exchange offer. In practice, exchange offers often succeed, so Assumption 4 is certainly too extreme. However, the basic results of the paper hold as long as the deadweight costs of renegotiation are larger with public debt. This seems to be the conventional wisdom (Smith and Warner, 1979; Brealey and Myers, 1991, Chap. 15). Also, an empirical study by Gilson *et al.* (1990) finds that the likelihood of restructuring outside of bankruptcy is smaller when few debt contracts are outstanding.[8]

The last assumption states that the amount of funds required at $t = 1$ is large relative to the continuation value of the firm at $t = 2$. As will be shown below, this assumption ensures that Myers' underinvestment problem arises with positive probability at $t = 2$.

Assumption 6. $I_1 > C(\omega_2)$.

Figure 1 summarizes the timing of the model.

2.2. *The Debt Renegotiation Game*

At $t = 2$, debt contracted with private creditors is renegotiated. Let D be the total contractual payment (interest and principal) due to private creditors, and let B denote the same for public creditors. Suppose also that private creditors are senior (the opposite priority assignment would not change the results). Debt renegotiation is modeled as a bargaining game between equity and the coalition of private creditors. The following extensive form is assumed: equity moves first, proposing a new debt contract D' (where D' is the new amount due at $t = 2$, including interest and principal). Then creditors respond by rejecting or accepting the offer.

[8] In contrast, for a sample of junk-bond issuers Asquith *et al.* (1991) find that the share of public debt does not significantly affect the likelihood of an out-of-court settlement.

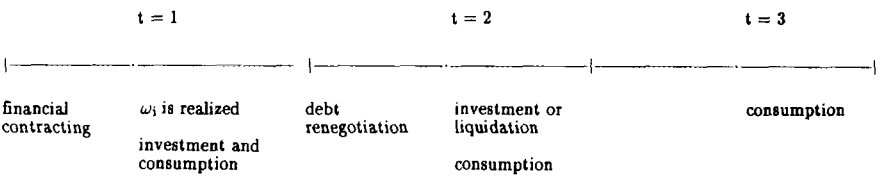

FIG. 1. The timing of the model.

If the offer is accepted, the old contract is void, and creditors are paid D'. This outcome will be referred to as "a successful renegotiation." If the offer is rejected, equity moves again, choosing between repayment according to the original contract and default. If default occurs, creditors force the firm into bankruptcy, and liquidation follows.

This extensive form game is special in that equity is given all the bargaining power (it makes a take-it-or-leave-it offer). However, all the results in the paper hold as long as the outcome of bargaining is efficient (no deadweight costs are paid in equilibrium) and equity captures at least some of the surplus from a successful renegotiation. Equilibria of full information bargaining games typically have these properties. Another peculiarity of the game is that equity automatically repays the offer D', if creditors accept. In principle, equity could choose to default on the new debt contract as well. However, this option has no strategic relevance in this context, and it has been eliminated for simplicity.

To find the set of subgame-perfect equilibria of this game, consider the last stage of the game, in which a renegotiation offer has been rejected, and equity must choose either to default or to repay $B + D$. Equity's best response is to repay if and only if

$$f(\omega_i) + C(\omega_i) \geq D + B, \tag{1}$$

where $f(\omega_i)$ is the cash flow from the first-period project. Consider now the creditors' best response to a renegotiation offer D'. If (1) holds, any offer $D' < D$ should be rejected, since creditors know that equity will repay the full contractual amount D. On the other hand, if (1) fails to hold, and if D' is such that $f(\omega_i) + C(\omega_i) \leq B + D'$, equity will invest, and liquidation will be avoided if creditors accept the offer. Is it a best response for creditors to accept? In liquidation, senior private creditors obtain a payoff of $\min[D, L]$. Hence, if $D < L$, private creditors have no incentive to make concessions since they can obtain the full contractual value of their claims in bankruptcy. On the other hand, if $D > L$, it is optimal to accept any offer $D' \geq L$. To summarize, if $D > \max[L, f(\omega_i) +$

$C(\omega_i) - B]$, creditors' best response is to accept any offer $D' \in [L, f(\omega_i) + C(\omega_i) - B]$. Otherwise, creditors' best response is to reject.

Let's now examine equity's choice of a renegotiation offer D'. If $D \leq \max[L, f(\omega_i) + C(\omega_i) - B]$, any offer will be rejected; hence the choice of D' is immaterial. On the other hand, if $D \geq \max[L, f(\omega_i) + C(\omega_i) - B]$, equity can offer creditors a new debt level as low as L, and creditors will accept. Is this strategy optimal? Only if the amount of public debt outstanding is small enough, namely

$$B \leq f(\omega_i) + C(\omega_i) - L. \tag{2}$$

If this condition fails, the concessions that can be obtained from private creditors are not sufficient to ensure a positive payoff for equity. In this case, in equilibrium equity makes an offer $D' < L$, which will be rejected. The strategies just described form a subgame-perfect Nash equilibrium. The unique equilibrium outcome induced by these strategies is described in the following lemma.

LEMMA 1. *At $t = 2$, if $D < f(\omega_i) + C(\omega_i) - B$, the original debt is repaid and the second-period investment is undertaken. If $D \geq f(\omega_i) + C(\omega_i) - B$ and either $D < L$ or $B > f(\omega_i) + C(\omega_i) - L$, the debtor defaults and the firm is liquidated. In all other cases, private creditors agree to write down their claims to $D' = L$, public creditors are repaid in full, and the second-period project is undertaken.*

Next, it will be shown that debt forgiveness is desirable whenever the cash flow from the first-period project is zero. This occurs in state 3 if the safe investment project is chosen and in states 2 and 3 if the risky project is chosen (see Table I).

LEMMA 2. *Under Assumptions 1–6, if the cash flow from the first-period project is zero it is not optimal for equity to invest in the second-period project unless debt is renegotiated.*

Proof. See Appendix.

The next lemma derives an upper bound on the public debt that can be issued without compromising successful renegotiation in state 3.

LEMMA 3. *In equilibrium, the firm continues with probability one at $t = 2$ if and only if*

$$B \leq C(\omega_3) - L. \tag{3}$$

Proof. See Appendix.

If (3) holds, a debt-forgiveness agreement is reached at $t = 2$ when $f(\omega_i) = 0$. In this case, private creditors and equity receive the following payoffs (see Lemma 1):

$$a^c(\omega_i) = L, \qquad a^e(\omega_i) = C(\omega_i) - (L + B). \tag{4}$$

Equity's payoff is nonnegative and decreasing in B, the payment owed to public debtholders. This explains why public debt plays a role in this model: in standard models of asset substitution, the risky project is attractive because limited liability curbs shareholders' losses in bad states and the costs of an unfavorable outcome are borne by creditors (Stiglitz, 1972; Jensen and Meckling, 1976). Here in bad states there is a going-concern surplus, and renegotiation allows equity to capture a positive payoff even if creditors are not fully satisfied. Hence, risky projects are even more attractive than in the standard case. However, if some debt is owed to creditors with whom it is impossible to renegotiate, equity's payoff in bad states is reduced and so are perverse incentives. Unfortunately, public debt cannot be increased arbitrarily without losses of going-concern value in some states. The optimal financial contract must trade off the costs of asset substitution with losses of going-concern surplus.[9]

2.3. *The Choice of the Investment Project at $t = 1$*

Let Δ denote the social cost of asset substitution, i.e., the difference between the expected cash flow from the safe project and from the risky project:

$$\Delta = (1 - p_3)r - p_1 R. \tag{5}$$

The results concerning the optimal financial structure and the welfare effect of alternative bankruptcy regimes depend on all the parameters describing the technology (the returns on the first-period project, the investment, the continuation value of the firm, the probabilities p_i, and, in Section 3, the deadweight costs of bankruptcy). In what follows, the different regions of the parameter space will be identified by the size of Δ relative to the other parameters.

Define

$$\alpha = p_2\{(1 - p_3)^{-1}[I_1 - p_3 C(\omega_3)] - C(\omega_3)\} \tag{6}$$

$$\beta = p_2\{(1 - p_3)^{-1}[I_1 - p_3 L] - L\}. \tag{7}$$

[9] Gorton and Kahn (1992) study a model of bank lending in which renegotiation occurs when banks learn private information about the firm at an interim date. In this setup, the ability to renegotiate is always value-increasing because it allows banks to prevent management from undertaking suboptimal actions.

TABLE II
PAYOFFS TO EQUITYHOLDERS AT $t = 2$ FOR EACH CHOICE OF PROJECT

	Project	
State	Safe	Risky
(ω_1)	$r - T + C(\omega_1)$	$R - T + C(\omega_1)$
(ω_2)	$r - T + C(\omega_2)$	$a^e(\omega_2)$
(ω_3)	$a^e(\omega_3)$	$a^e(\omega_3)$

Under the maintained assumptions, $\beta > \alpha > 0$. The next proposition shows that when the costs of asset substitution are large it is credible for equity to choose the safe project at $t = 1$, even without public debt. In this case, there is no need to borrow from public sources. On the other hand, for lower values of Δ first-best efficiency can be achieved only by issuing both types of debt.

PROPOSITION 1. *If $\Delta \geq \beta$, investment is first-best even if the firm borrows only from private sources. If $\alpha \leq \Delta < \beta$, investment is first-best only if both public and private debt are issued in period* 1. *The outcome is not first-best if $\Delta < \alpha$.*

Proof. Choose B to satisfy (3), and define $T = B + D$. When the second-period cash flow is zero, renegotiation results in debt forgiveness, and the payoff to equity is given by Eq. (4). Equity's payoff for each project choice and in each state of nature is shown in Table II. Accordingly, equity is better off choosing the safe project if and only if

$$\Delta \geq p_2[T - C(\omega_2) + a^e(\omega_2)]. \tag{8}$$

The LHS is positive by Assumption 1, but the RHS is also positive both because $T > I_1 > C(\omega_2)$ *and* because $a^e(\omega_2) > 0$. In equilibrium, the amount disbursed by public creditors is B; hence for private creditors to break even it must be that $D = (1 - p_3)^{-1}[(I_1 - B) - p_3 L)]$. In equilibrium, the total contractual repayment is

$$T = (1 - p_3)^{-1}[I_1 - p_3(B + L)]. \tag{9}$$

Note that T is decreasing in B, the amount of public debt: as long as there is no loss of going-concern value in state 3, increasing B results in a higher payoff for creditors as a group in the low cash-flow state, and hence it reduces the average interest rate paid by the debtor. Substituting into (8), and using (4),

$$\Delta \geq p_2\{(1 - p_3)^{-1}[I_1 - p_3(B + L)] - L - B\}. \tag{10}$$

The RHS of this expression is a decreasing function of the amount of public debt: a larger B makes asset substitution less attractive both because it reduces the average interest rate and because it reduces equity's state-2 payoff from choosing the risky project. For $B = 0$, the RHS of (8) is equal to β, while if $B = C(\omega_3) - L$, the expression is equal to α. If $\Delta > \beta$, the firm does not need to issue public debt since creditors (correctly) believe that the safe project will be chosen anyway. On the other hand, if $\Delta \leq \beta$, the firm needs to issue some public debt to commit to the safe project. Finally, if $\Delta < \alpha$, first-best efficiency is not obtained. ■

Suppose that $\Delta < \alpha$. Now the only way to make asset substitution suboptimal for equity is to increase the amount of public debt beyond $C(\omega_3) - L$. This would reduce $a^e(\omega_2)$ even further, making the risky project less attractive (Eq. (8)). Such a strategy, however, leads to the liquidation of the firm in state 3; hence it is certainly not optimal if the cost of asset substitution is smaller than the expected loss in going-concern value ($\Delta < p_3[C(\omega_3) - L]$). Furthermore, such a strategy may not work, because liquidation in state 3 lowers creditors' payoff in that state, increasing the equilibrium total contractual repayment T. In other words, an increase in B pushes up the average interest rate, making asset substitution more appealing. In general, there are parameter values for which the effect on $a^e(\omega_2)$ dominates, and it is possible to trade off asset substitution for going-concern value. These intuitive results are made precise in the next proposition.

Define

$$\delta = p_2\{(1 - p_3)^{-1}[I_1 - p_3 L] - C(\omega_2)\} \tag{11}$$

$$\gamma = \max\{\delta, p_3[C(\omega_3) - L]\}. \tag{12}$$

PROPOSITION 2. *If $\alpha > \Delta \geq \gamma$, equity issues enough public debt to induce inefficient liquidation in state ω_3, but invests in the safe project at $t = 1$. Otherwise, the risky project is undertaken.*

Proof. See Appendix.

The dark line in Fig. 2 shows the *ex ante* efficiency loss as a function of the cost of asset substitution Δ when there is no reorganization law. The figure is drawn for the case of $\delta < p_3[C(\omega_3) - L]$ and $\delta < \alpha$.

Propositions 1 and 2 show that it may be optimal for firms to borrow both through private debt contracts and through publicly traded securities. In a related paper, Bergman and Callen (1991) present a model in which managers' ability to extract surplus in debt renegotiation affects the

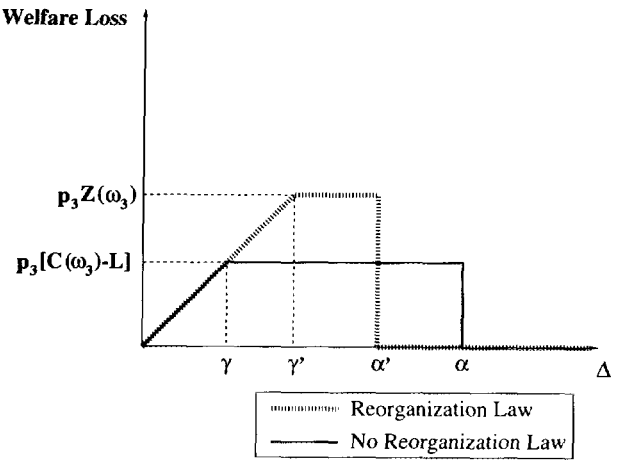

FIG. 2. The welfare loss with no reorganization law and with a reorganization law that respects APR for different values of the cost of asset substitution Δ.

firm's financial structure. In their model, firms have only one project, outside equity contracts are feasible, and debt has tax advantages. Shareholders' *ex post* bargaining power results in a credit ceiling that can be binding in equilibrium, so some projects must be partially financed through equity. Bergman and Callen suggest that issuing public debt, by reducing managers' bargaining power in debt renegotiation, might increase the credit ceiling. So firms may issue public debt even if transaction costs are higher. This model implies a positive demand for public debt only by firms that are constrained in the private debt market, which is not very realistic. Also, the model predicts a positive demand for private debt only if public debt is more expensive for the borrower (higher issuing costs are not compensated by lower interest rates). In the model presented here, firms issue publicly even though they can finance the entire investment in the private market. Also, even if the higher flotation cost of public debt is offset by lower interest rates, private debt could still be in demand.

3. COURT-SUPERVISED REORGANIZATION

In the previous section the only alternative to a voluntary agreement between private creditors and equity was the liquidation of the firm. Here, the option of restructuring publicly traded debt in a court-supervised reorganization is introduced. Several features of reorganization laws are

designed to reduce coordination problems among creditors: in the U.S. system, for instance, Chapter 11 imposes an "automatic stay" on creditors, which prevents runs against the company's assets in case of default. In addition, the reorganization plan must be approved only by a ⅔ majority of any impaired class (creditors who receive the full value of their claims are deemed unimpaired and do not vote). Furthermore, while the negotiations take place, the judge can allow "debtor in possession" financing, which ranks above all other debt. This provision ensures that operations can continue while a settlement is negotiated. Finally, a reorganization plan can be imposed on a dissenting class of claimants if the plan is deemed "fair and equitable" by the judge (cram-down provision). This standard is usually thought to be satisfied if claimants receive at least what they would receive in liquidation (White, 1989). All these provisions violate the contractual rights of creditors. Supervision by the bankruptcy judge—although costly—should ensure that contractual violations only occur if they are in the best interest of the creditors themselves.[10]

The option of seeking a court-supervised reorganization modifies the bargaining game played by equity and private creditors when they try to settle out of court. More specifically, in case of default, equity can now choose either to file for liquidation or to file for court-supervised reorganization. What follows assumes that court intervention results in deadweight costs. Let $Z(\omega_i) = F + zC(\omega_i)$ be these costs, with $F > 0$ and $0 < z < 1$. The fixed component F captures court and legal fees and other direct costs, while the variable component captures the loss in continuation value experienced while in court (indirect costs). Indirect costs may arise from lost investment opportunities and from disclosure of private information. For simplicity, it is assumed that $L > Z(\omega_i)$ for all i. Also, court costs are assumed to be paid out of the firm's assets, as is the case in most countries (Mitchell, 1990).

3.1. *Distribution According to the APR*

Several proposals to reform Chapter 11 have stressed the need for a system that respects the APR, thereby maintaining equity value only if the firm turns out to be fully solvent or if it improves managerial incentives (Bebchuck, 1988; Aghion *et al.*, 1993). The first reorganization law examined is assumed to have this property.

Denote by $g^e(\omega_i)$, $g^c(\omega_i)$, and $g^p(\omega_i)$ the payoffs to shareholders, private creditors, and public creditors when a reorganization agreement is reached in court. Since the firm is always viable, reorganization results in an agreement that allows the firm to continue. Since private debt is senior

[10] For an overview of bankruptcy laws in countries other than the United States, see Mitchell (1990).

and APR is respected in the division, payoffs are

$$\begin{aligned} g^e(\omega_i) &= \max[C(\omega_i) + f(\omega)_i) - Z(\omega_i) - (B + D), 0], \\ g^p(\omega_i) &= \min[C(\omega_i) + f(\omega)_i) - Z(\omega_i) - D, B], \\ g^c(\omega_i) &= \min[C(\omega_i) + f(\omega)_i) - Z(\omega_i), D]. \end{aligned} \tag{13}$$

The next step is to study the bargaining game between private creditors and shareholders before a bankruptcy petition is filed. Under APR, in case of default, equity is indifferent between filing for reorganization or liquidation. Here it will be assumed that the former option is always chosen: if the model is modified by introducing a small probability that the firm could become solvent while in court, equityholders would strictly prefer reorganization since the option value of their claims would be preserved. Under this assumption, the new bargaining game is identical to that of Section 2, except that now a decision to default leads to a court-supervised restructuring, in which case payoffs are as in (13). This outcome is more efficient than liquidation only if $C(\omega_i) - Z(\omega_i < L$, a condition which will not be assumed to hold in general. Lemma 1 of Section 2 can now be restated as follows:

LEMMA 4. *At $t = 2$, if $D < f(\omega_i) + C(\omega_i) - B$, the original debt is repaid and the second-period investment is undertaken. If $D \geq f(\omega_i) + C(\omega_i) - B$, and either $D < f(\omega_i) + C(\omega_i) - Z(\omega_i)$ or $B > Z(\omega_i)$, the firm is reorganized in court. In all other cases, private creditors agree to write down their claims to $D' = f(\omega_i) + C(\omega_i) - Z(\omega_i)$, and the firm invests in the second-period project without going to court.*

As in the previous section, if $f(\omega_i)$ is zero only a debt-reduction agreement can prevent a bankruptcy filing at $t = 2$ (Lemma 2 still holds). The next lemma, similar to Lemma 3 of Section 3, provides an upper bound on the amount of public debt that can be issued without compromising successful renegotiation out of court.

LEMMA 5. *At $t = 2$, the firm continues with probability on without going to court if and only if*

$$B \leq Z(\omega_3). \tag{14}$$

Proof. Proceed as in the proof of Lemma 3, taking into account that the outcome of renegotiation is now described by Lemma 4. ■

If $f(\omega_i) = 0$ and if (14) holds, debt is successfully renegotiated at $t = 2$. In this case, the payoffs to private creditors and to equity are respectively

$$a^c(\omega_i) = C(\omega_i) - Z(\omega_i), \qquad a^e(\omega_i) = Z(\omega_i) - B. \tag{15}$$

As in Section 2, $a^e(\omega_i)$ is decreasing in the public debt outstanding. Let's now turn to the choice of the financial structure at $t = 1$. With the reorganization law the equilibrium is first-best if no court costs are paid and if the safe project is undertaken at $t = 1$. The reorganization law then has two effects on *ex ante* efficiency. First, when parameter values are such that equity chooses to incur court costs to commit to the safe project, the reorganization law is welfare improving if and only if court costs are less than the going concern surplus in state 3. This is what *ex post* efficiency considerations would suggest: given that equity always chooses to reorganize, the new bankruptcy regime improves welfare if and only if reorganization yields smaller deadweight costs than liquidation. The second effect is less intuitive: with the reorganization law, the region of the parameter space in which the first-best outcome is attainable is larger regardless of whether reorganization costs are smaller than the going concern surplus. Hence, if the deadweight costs of reorganization are small relative to the loss of going concern value in liquidation, a reorganization law that respects APR is unambiguously welfare improving. However, the law may be welfare improving even if liquidation is more efficient than reorganization *ex post* because it is more likely that both court intervention and asset substitution can be avoided in equilibrium.

To derive the financing decision at $t = 1$, define

$$\alpha' = p_2\{(1 - p_3)^{-1}[I_1 - p_3C(\omega_3)] - C(\omega_2) + Z(\omega_2) - Z(\omega_3)\}, \quad (16)$$

$$\beta' = p_2\{(1 - p_3)^{-1}[I_1 - p_3(C(\omega_3) - Z(\omega_3))] - C(\omega_2) + Z(\omega_3)\}. \quad (17)$$

PROPOSITION 3. *With a reorganization law such that APR is respected in the settlement, the results of Proposition* 1 *hold, as long as* α' *and* β' *replace* α *and* β. *Since* $\alpha' < \alpha$, *the set of parameter values for which first-best investment can be achieved is larger.*

Proof. The proof is identical to that of Proposition 1, except that $a^c(\omega_i)$ and $a^e(\omega_i)$ are now given by (15) and costly court intervention replaces liquidation. To see that $\alpha' < \alpha$, recall that without reorganization the safe project is preferred if

$$\Delta \leq p_2\{T - C(\omega_2) + a^e(\omega_2)\},$$

where $a^e(\omega_2) = C(\omega_2) - L - B$ and $T = (1 - p_3)^{-1}[I_1 - p_3(L + B)]$. With the reorganization law, the inequality above is still the relevant one, but $a^e(\omega_2) = Z(\omega_2) - B$ and $T = (1 - p_3)^{-1}\{I_1 - p_3[C(\omega_3) - Z(\omega_3) + B)]\}$. Then α is the RHS of the inequality above calculated at $B = C(\omega_3) - L$, and α' is the same expression calculated at $B = Z(\omega_3)$. Note that the total contractual amount of debt T is the same with or without reorganization. How-

ever, the value of $a^e(\omega_i)$ is different and

$$\alpha - \alpha' = p_2(1 - p_3^{-1}\{[C(\omega_2) - C(\omega_3)] - [Z(\omega_2 - Z(\omega_3)]\}.$$

Using the definition of $Z(\omega_i)$,

$$\alpha - \alpha' = p_2(1 - p_3)^{-1}(1 - z)[C(\omega_2) - C(\omega_3)] > 0. \tag{18}$$

Because the deadweight costs of reorganization are partially fixed, the minimum $a^e(\omega_2)$ that is consistent with successful out-of-court renegotiation is smaller. Hence, with a reorganization law that respects APR, the region of parameter space in which an adequate choice of the financial structure avoids both asset substitution and *ex post* inefficiencies is larger. ■

The next proposition describes the financial decision when $\Delta < \alpha'$ and compares the *ex ante* welfare loss with that of Section 3. Define

$$\delta' = p_2[(1 - p_3)^{-1}\{I_1 - p_3[C(\omega_3) - Z(\omega_3)]\} - C(\omega_2)],$$

$$\gamma' = \min[\delta', p_3 Z(\omega_3)].$$

PROPOSITION 4. *If $\alpha' > \Delta \geq \gamma'$, the firm undertakes the safe project at $t = 1$, but the amount of public debt issued is large enough that the firm is reorganized in court in state 3. Otherwise, the risky project is undertaken. When $\Delta < \alpha'$, the reorganization law is welfare improving if and only if $Z(\omega_3) \leq C(\omega_3) - L$.*

Proof. See Appendix.

Figure 2 shows the welfare loss under the two regimes in the case of $C(\omega_3) - L < Z(\omega_3)$ and $\delta' < \alpha'$. In this case, the welfare effects of introducing the reorganization law are ambiguous.

Thus far, the analysis neglects a potential source of inefficiency that may arise when a reorganization law is introduced. In the model, the firm is assumed to be always viable in period 2. Suppose, instead, that states of nature in which $C(\omega_i) < L$ can arise. In the model of Section 2, the firm would be liquidated in these states, which is the *ex post* efficient outcome. If a reorganization law exists, equity is likely to go to court to preserve the option value of its claims in these states. This problem is compounded if equity can delay the settlement (this is often the case in the United States), since delay increases the option value of reorganization. Also priority violations in favor of equityholders increase the bias in the filing decision. Baird (1990) observes that in the United States the bankruptcy judge can dismiss a case if reorganization appears unlikely. Also, creditors can petition the judge to end reorganization efforts. Unfortunately,

judges are unlikely to possess the information needed to make the correct decision, while gathering information incurs the verification costs that one would like to avoid. A partial solution could be to reduce the time companies are allowed to spend in reorganization, as proposed by Aghion *et al.* (1993) and by Altman (1993). Also, filing rules could be revised, giving creditors more power or forcing claimants who want a reorganization to pay some of the costs up front, as in the Japanese system (Mitchell, 1990). Designing rules that implement the socially efficient filing decision is a complex and interesting problem that has not received much attention in the bankruptcy literature.

3.2. *Priority Violations in Reorganization*

Consider now a reorganization law that does not constrain the settlement to respect APR, and suppose that equity has sufficient bargaining power to obtain a nonzero payoff in court. If the firm files for bankruptcy, this regime is as inefficient as the previous one, as it gives rise to the same deadweight cost $Z(\omega_i)$. *Ex ante*, however, a bankruptcy regime that allows APR violations hinders equity's ability to precommit to the safe project and makes inefficient outcomes more likely. As a result, the region of the parameter space in which the outcome is first-best becomes smaller. Also, the region in which it is possible to trade off court costs for asset substitution becomes smaller, while the terms of the trade-off remain unchanged (see Fig. 3). Hence, priority violations in reorganization unambiguously reduce welfare.

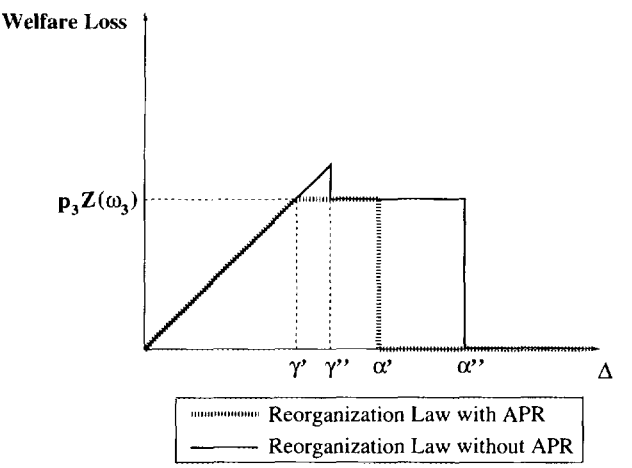

FIG. 3. The welfare loss when APR is enforced by the reorganization law and when it is not for different values of the cost of asset substition Δ.

Let $E > 0$ denote the payoff that equity extracts in a court-supervised reorganization. For simplicity, E is assumed not to be state dependent. If the firm goes to court, payoffs are now

$$\begin{aligned} g^e(\omega_i) &= \max[C(\omega_i) + f(\omega_i) - Z(\omega_i) - (B + D), E], \\ g^p(\omega_i) &= \min[C(\omega_i) + f(\omega_i) - Z(\omega_i) - D - E, B], \\ g^c(\omega_i) &= \min[C(\omega_i) + f(\omega_i) - Z(\omega_i) - E, D]. \end{aligned} \tag{19}$$

The analysis of the out-of-court debt renegotiation game yields the following:

LEMMA 6. *At $t = 2$, if $D < f(\omega_i) + C(\omega_i) - B - E$, the original debt is repaid and the second-period investment is undertaken. If $D \geq f(\omega_i) + C(\omega_i) - B - E$ and either $D < f(\omega_i) + C(\omega_i) - Z(\omega_i) - E$ or $B > Z(\omega_i)$, the firm is reorganized in court. In all other cases, private creditors agree to write down their claims to $D' = f(\omega_i) + C(\omega_i) - Z(\omega_i) - E$, and the firm invests in the second-period project without going to court.*

Both Lemma 2 of Section 2.2 and Lemma 5 of Section 3.1 still hold. Hence, if $B \leq Z(\omega_3)$ and $f(\omega_i) = 0$, equity obtains a debt-reduction agreement without going to court. Public debtholders receive the entire value of their claims, while equity and the private creditor obtain respectively

$$a^e(\omega_i) = E + Z(\omega_i) - B, \qquad a^c(\omega_i) = C(\omega_i) - Z(\omega_i) - E. \tag{20}$$

For given B, equity's payoff in out-of-court renegotiation is larger than that under the previous bankruptcy regime. This makes asset substitution at $t = 1$ more attractive and the commitment problem more difficult. Proceeding as in the previous section, the minimum value of Δ (the social cost of asset substitution) that is consistent with a first-best outcome is now

$$\alpha'' = p_2[(1 - p_3)^{-1}\{I_1 - p_3[C(\omega_3) - E]\} - C(\omega_2) + Z(\omega_2) - Z(\omega_3) + E\}. \tag{21}$$

This expression is increasing in E, the payoff that equity obtains in reorganization, and it is equal to α' when $E = 0$, i.e., when contractual priority is respected. Hence, the set of parameter values for which the outcome is first-best is smaller when $E > 0$.

If $\Delta < \alpha''$, at $t = 1$ the firm can consider precommitting to the safe project by issuing $B > Z(\omega_3)$ and bearing court costs in state 3. This is feasible if

$$\Delta \geq \delta'' = p_2[(1 - p_3)^{-1}\{I_1 - p_3[C(\omega_3) - Z(\omega_3) - E] - C(\omega_2) + E\}].$$

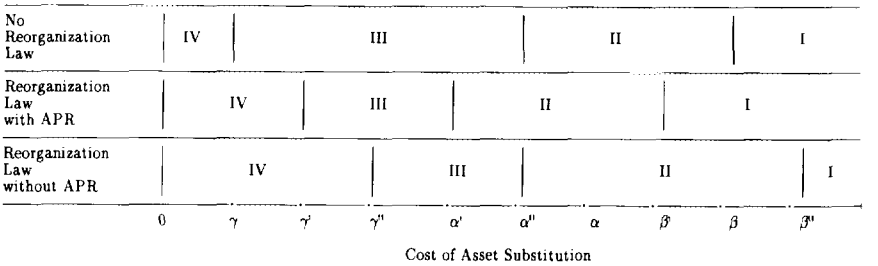

FIG. 4. The optimal capital structure under alternative bankruptcy regimes and for different values of the cost of asset substitution Δ. I, the debtor is indifferent between public and private debt. II, the debtor must issue both types of debt. III, the debtor must issue a minimum amount of public debt. IV, the debtor must issue a minimum amount of private debt.

Such a strategy is optimal if the cost of asset substitution exceeds the cost of going to court in state 3, i.e., if $\Delta \geq p_3 Z(\omega_3)$. Let $\gamma'' = \min[\delta'', p_3 Z(\omega_3)]$. Then, in equilibrium, the firm invests in the safe project and is reorganized in court in state 3 if $\alpha'' < \Delta \leq \gamma''$. Otherwise, equity chooses the risky project. Since δ'' is increasing in E and it is equal to δ' for $E = 0$, it must be $\gamma'' \geq \gamma'$. Hence, the set of parameter values for which it is possible to trade off court costs for asset substitution is smaller than that in the previous bankruptcy regime, as shown in Fig. 3.

PROPOSITION 5. *A bankruptcy regime in which priority violations in equity's favor occur when firms are reorganized in court is Pareto-dominated by a regime in which priority is respected in the settlement.*

Figure 4 summarizes the optimal choice between public and private debt financing under the three alternative bankruptcy regimes.

Some authors (White, 1989; Gertner and Scharfstein, 1991) have suggested that *ex post* violations of contractual priority in favor of shareholders may be efficiency improving in some circumstances: if managers expect equity value to be wiped out in bankruptcy, they will attempt to avoid filing by investing in negative present value projects, selling off assets, or raiding employee pension funds. However, as others have pointed out (Bradley and Rosenzweig, 1992; Aghion *et al.*, 1993), tight loan covenants are likely to limit opportunities for suboptimal investment. For instance, covenants that prohibit managers from liquidating productive assets to finance investment are fairly common (Smith and Warner, 1977). Furthermore, investment in negative present value projects is possible only if the firm has the needed cash flow, while it is profitable for shareholders only if future debt payments are large. If loan maturities

match investment returns, this situation is unlikely to arise. In short, with appropriate contract design priority violations *ex post* can be overcome.

4. EXTENSIONS

4.1. *Asset Substitution in Period 2*

Thus far, asset substitution could occur only at the first date, while in the second period only one investment project was available. In a more general framework, bargaining in insolvency states would affect not only the choice between continuation and liquidation, but also the choice between projects of different risk. Private creditors and equity would have an incentive to design the restructuring agreement to induce the socially efficient choice of project. Accordingly, the welfare loss from holding debt that is hard to renegotiate might consist of a suboptimal project choice at $t = 2$, instead of the loss of going concern value. A model along these lines is likely to yield conclusions similar to those above.

4.2. *Long-Term Contracts*

Contracts were assumed to mature in one period, and one might wonder whether the parties could avoid debt renegotiation by writing a two-period loan contract. For instance, suppose that all debt matures at $t = 3$ and no interest is due at $t = 2$. In this case, at $t = 2$, when $f(\omega_i) = 0$ equity must raise external funds in order to finance the second-period project. For long-term creditors to break even, the debt due at $t = 3$ must be at least $D + B = I_1$. Since $C(\omega_2) < I_1$, new investors would be willing to finance the second-period project only if they were made senior to long-term creditors. In other words, the second-period project must be financed by diluting the value of long-term debt. If long-term debt has covenants forbidding issuance of higher priority debt, no new financing can be obtained, and the second-period project is undertaken only if long-term debt can be renegotiated. If long-term debt had no seniority covenants, then in state 1 equityholders would borrow $C(\omega_1) + I_2$, granting seniority to new lenders; they would consume $r + C(\omega_1)$, invest I_2, and default completely on long-term debt at $t = 3$. Long-term creditors, foreseeing this behavior, would be unwilling to lend without a seniority covenant.

4.3. *Secured Debt*

If creditors could be fully secured, investment would always be first-best. However, since the value of the firm's assets that can be used as collateral presumably does not exceed the liquidation value of the firm,

firms under examination do not have this opportunity. Granting security only to some creditors would not change the results: consider the case in which private debt is senior, and suppose that there is a secured lender who is entitled to collateral worth exactly L, the liquidation value of the firm. Whether the secured loan is privately placed or publicly traded, it has to be repaid in full in case of renegotiation, since the creditor has nothing to lose from a liquidation. The payoff to equity if renegotiation succeeds is $C(\omega_i) - L - B$, while creditors as a group receive $B + L$. These are the same payoffs derived in Section 2. Collateral may play a role if it raises the overall liquidation value of the firm. This may happen if monitoring by secured claimants prevents managers from selling part of the assets or from failing to appropriately maintain them before financial distress is experienced.

4.4. *Outside Equity*

The model would be more realistic if it allowed for the existence of some outside equity along with private and public debt. Assumption 3 rules out outside equity by stating that the cash flow is unverifiable. Seward (1990) assumes that a fraction of total cash flow can be verified *ex post* by a third party. In this case, a limited amount of outside equity can be issued. A similar assumption could be introduced in my model. Then, I_1 would need to be redefined as the amount of investment that *cannot* be financed with outside equity. If the verifiable portion of cash flow is sufficiently large, both asset substitution at $t = 1$ and debt renegotiation at $t = 2$ could be avoided, and the firm would be indifferent between issuing public and private debt.

4.5. *Arbitration*

In the environment described here, the need for a reorganization law arises because of contract incompleteness: if the realization of ω_i was verifiable, debt contracts could specify how to allocate the going-concern surplus in case of default, and *ex post* renegotiation could be avoided (such contracts would be essentially equity contracts). As Gibbons (1988) observes, in a world of incomplete contracts an alternative to both *ex post* bargaining and court intervention is private arbitration.[11] For arbitration to work, the parties must explicitly waive their right to sue and commit themselves to abide by the arbitrator's decision. Hence, the circumstances and procedures of arbitration are specified in the initial contract.

The outcome of a court-supervised reorganization could perhaps be achieved at a lower deadweight cost if debt contracts contained arbitration provisions. For instance, contracts could specify that if a default

[11] I thank a referee for pointing this out.

persists for some length of time creditors must "stay" their actions and let an arbitrator decide what to do with the firm. The analysis of Section 3 suggests that the arbitrator should be required to follow the APR to improve *ex ante* efficiency. This implies that he must have the power to alter contracts that may not have been defaulted on (in case the debtor defaults only on senior claims). Hence, all contracts should contain cross-default clauses stating that a default on any obligation of the debtor will lead to the restructuring of all claims (or at least of claims that are either junior or of equal priority to the claim in default). For such a scheme to work, a considerable amount of consistency across contracts is needed: all debt contracts must anticipate the use of arbitration under the same circumstances and according to the same procedures. This problem is likely to make arbitration more difficult to use in debt restructuring than in disputes involving a single contract or only two parties. Also, in the United States Chapter 11 is used to settle corporate obligations toward noncontractual claimants, such as customers involved in product liability suits (Graham, 1992). Clearly, private arbitration could not substitute for court intervention in such cases.

5. EMPIRICAL IMPLICATIONS

The theory presented here rests on the assumption that private debt is easier to renegotiate than public debt. Studies of actual private workouts–along the lines of Gilson *et al.* (1990) and Asquith *et al.* (1991)–can provide direct evidence of private creditors' willingness to make concessions in the absence of public debt restructuring. Indirect evidence of the plausibility of this assumption is obtainable via empirical studies of interest rates on public and private debt: if there are states of nature in which private debt is written down while public debt is not, then the private debt of firms with nonnegligible risk of default should carry a higher interest rate.

The model also predicts the optimal capital structure. The theory focuses on differences in renegotiation costs as the only relevant distinction between public and private debt, thus overlooking aspects such as liquidity, issuing costs, divisibility, and monitoring costs, which are clearly important in practice. These aspects need to be integrated into the analysis before any empirical investigation is attempted. Another problem is that there are regions of the parameter space in which firms are indifferent between issuing private and public debt. This makes it difficult to predict the relationship between observed capital structures and firm characteristics. A possible way around this problem is to identify a class of firms for which–in the absence of asset substitution and of renegotiation costs–either type of debt is cheaper. For instance, it is plausible that public debt

is cheaper than private debt for large companies since the transaction costs of a public issue are largely fixed. Then the model would predict that large companies borrow from private creditors only to avoid losses of going-concern surplus (or the deadweight costs of court-supervised restructuring) in low cash-flow states. A proxy for the going-concern surplus (or the indirect costs of bankruptcy) could be the share of intangible assets in total assets. Then the theory would predict that large firms with small intangible assets use only publicly traded debt, while large firms with greater intangible assets use both instruments.

On the other hand, according to the model, firms for which it is more expensive to issue publicly (smaller firms) should use publicly traded debt only to reduce equity's payoff in renegotiation states. This payoff is larger, the larger the going-concern surplus (or the larger the court costs). In this case, we would expect to observe some firms borrowing only from private sources, and some highly indebted firms with large intangible assets using public debt as well.

MacKie-Mason (1990) estimates a discrete-choice model of the financing decision for a sample of U.S. firms. One of the specifications yields estimates of the probability that—given that debt financing is used—a firm will issue both public and private debt as opposed to only private debt.[12] The author finds that firms more likely to use both markets have more intangible assets (measured by advertising and R & D expenses). Conditional on private loans being cheaper than public issues, MacKie-Mason's findings would support the predictions of the model presented here.

6. CONCLUSIONS

This paper develops a model of the optimal financial structure, in which firms hold two classes of debt that differ only in their renegotiation costs. Low renegotiation costs improve investment in times of financial distress, but they worsen incentives for asset substitution over and above those created by limited liability. The need to strike a balance between *ex ante* commitment and *ex post* efficiency leads firms to use both kinds of debt.

The theory is simple, but it begs the question of what real world debt contracts correspond to the two securities considered here. Empirical studies of debt workouts can shed light on whether firms obtain concessions from private creditors more readily than from public debtholders.

[12] MacKie-Mason considers the binary choice between public/private debt. However, firms are classified as using private debt financing when they do not issue any publicly traded bonds. This leaves firms that use both types of debt in the public debt category.

Further theoretical work may also clarify the costs of renegotiating public debt. A model of exchange offers in which bondholders have differing valuations of the firm and holdings of different amounts could yield interesting insights. Also, the assumption that public and private debt are perfect substitutes except for renegotiation costs—although convenient for highlighting the importance of financial distress—is obviously too simple. Large firms are likely to prefer public debt, since issuing costs are essentially fixed. Also, younger companies probably use bank loans because they need the monitoring services of financial intermediaries (Diamond, 1991). Integrating all these elements into the model is necessary before any serious empirical test is attempted.

In the model, both the choice of the financial structure and the efficiency of the investment decision are affected by the bankruptcy regime. The welfare effects of bankruptcy laws that facilitate corporate reorganization, such as Chapter 11 in the United States, are evaluated taking into account that firms choose their optimal financial structure based on the bankruptcy regime. Two problems with U.S. law are identified: first, the bargaining power given to shareholders and managers encourages excessive risk-taking *ex ante*. Reforming the law to ensure that settlements respect contractual priority unambiguously increases welfare relative to the current system. Second, because equityholders maintain the option value of their claims by filing for a reorganization, the filing decision is biased against liquidation. More work is needed to identify rules that can implement the socially efficient filing decision.

APPENDIX

Proof of Lemma 2. Let $B + D$ be the total amount of debt (principal and interest) due at $t = 2$. To sustain the initial investment, it must be that $B + D \geq I_1$. By Assumption 6, $I_1 < C(\omega_2) > C(\omega_3)$. Hence, inequality (1) is violated if $f(\omega_i) = 0$, and equity is better off defaulting in the absence of debt forgiveness. ■

Proof of Lemma 3. Consider the debt renegotiation game at $t = 2$. By Lemma 1, liquidation occurs if $D + B > C(\omega_i) + f(\omega_i)$ and either $B > C(\omega_i) + f(\omega_i) - L$ or $D < L$. By Lemma 2, in states in which $f(\omega_i) = 0$, it must be that $D + B > C(\omega_i)$ in equilibrium. Hence, if $B > C(\omega_3) - L$, renegotiation fails in state 3. This proves that (3) is a necessary condition. To show sufficiency, note that for bankruptcy to occur with positive probability when (3) holds, there must be a state in which $D + B > C(\omega_i) + f(\omega_i)$ and $D < L$. From (3), $B \leq L + C(\omega_i) + f(\omega_i)$. Adding D to both sides, this inequality becomes $D + B \leq (D - L) + C(\omega_i) + f(\omega_i)$,

which is consistent with $D + B > C(\omega_i) + f(\omega_i)$ only if $D > L$. Hence, if (3) holds, renegotiation at $t = 2$ never results in liquidation of the firm. ■

Proof of Proposition 2. Suppose that the firm has issued $B \geq C(\omega_2) - L$. In this case, the firm is liquidated in state 3; hence

$$T = (1 - p_3)^{-1}(I_1 - p_3 L).$$

Comparison with (9) reveals that total contractual repayment is larger in this case: creditors obtain a smaller payoff in state 3, so they demand a higher interest rate. If the risky project is chosen, liquidation takes place also in state 2, and equity obtains a payoff of zero. At $t = 1$, the safe project is more profitable for equity if

$$\Delta \geq p_2[(1 - p_3)^{-1}(I_1 - p_3 L) - C(\omega_2)] = \delta.$$

Note that δ may be larger than α: in this case, the incentives for asset substitution that arise from the increased interest rate are stronger than the disincentives that arise from a lower $a^e(\omega_2)$. Hence, when $\Delta < \alpha < \delta$ the equilibrium outcome is for equity to choose the risky project (and issue little or no public debt). On the other hand, if $\alpha > \Delta \geq \delta$, the interest rate effect of an increase in B is dominated by the effect on $a^e(\omega_2)$, and the firm can commit to the safe project by issuing a sufficient amount of public debt at $t = 1$. This commitment is costly, however, because it results in the loss of going-concern value in state 3. Hence, if $p_3[C(\omega_3) - L] > \Delta$ equity is better off undertaking the risky project and issuing little or no public debt. Finally, if $\alpha > \Delta > \max\{\delta, p_3[C(\omega_3) - L]\}$ it is optimal for equity to issue $B > C(\omega_2) - L$ and to undertake the safe project. ■

Proof of Proposition 4. Proceeding as in the proof of the Proposition 3, suppose $B > Z(\omega_2)$. Then in equilibrium

$$T = (1 - p_3)^{-1}\{I_1 - p_3[C(\omega_3) - Z(\omega_3)]\}.$$

If the risky project is undertaken, the firm is reorganized in court in state 2, and equity's payoff is zero. Hence, at $t = 1$ equity chooses the safe project if

$$\Delta \geq p_2[(1 - p_3)^{-1}\{I_1 - p_3[C(\omega_3) - Z(\omega_3)]\} - C(\omega_2)] = \delta'.$$

Accordingly, if $\alpha' > \Delta \geq \min[\delta', p_3 Z(\omega_3)]$, at $t = 1$ it is optimal to issue $B > Z(\omega_2)$, undertake the safe project, and reorganize in court in state 3. On the other hand, if either $\alpha' > \delta'$ or $\Delta < \min[\delta', p_3 Z(\omega_3)]$, the risky project is undertaken at $t = 1$. The welfare loss is, therefore, zero for $\Delta \geq \alpha'$, it is $p_3 Z(\omega_3)$ for $\alpha' > \Delta \geq \min[\delta', p_3 Z(\omega_3)]$, and it is Δ otherwise.

Note that, when $[C(\omega_3) - L] < Z(\omega_3)$, $\delta' > \delta$ so that $\gamma' \geq \gamma$. Now, when $\gamma \leq \Delta \leq \alpha'$ the welfare loss with the reorganization law is $\min[\Delta, p_3 Z(\omega_3)]$, while without the law it is $\min\{\Delta, p_3[C(\omega_3) - L]\}$ (see Fig. 2). Hence, the loss is larger with the reorganization law, and the welfare comparison between the two regimes is ambiguous. On the other hand, if the deadweight costs of reorganizing in court are smaller than the loss of going-concern value in state 3 ($[C(\omega_3) - L] > Z(\omega_3)$), $\gamma' \leq \gamma$, and the welfare loss when $\gamma \leq \Delta \leq \alpha'$ is $p_3 Z(\omega_3)$ with reorganization law and $p_3[C(\omega_3) - L]$ without the law. Hence, the reorganization law is unambiguously welfare improving. ■

REFERENCES

AGHION, P., HART, O., AND MOORE, J. (1993). The economics of bankruptcy reform, *J. Law Econ. Organ.* **8,** 523–546.

ALTMAN, E. (1993). "Corporate Financial Distress and Bankruptcy." Wiley, New York.

ASQUITH, P., GERTNER, R., AND SHARFSTEIN, D. (1991). "Anatomy of Financial Distress: An Examination of Junk-Bond Issuers," NBER Working Paper No. 3942.

BAIRD, D. (1990). The initiation problem in bankruptcy, *Int. Rev. Law Econ.* **11,** 223–232.

BEBCHUCK, L. (1988). A new approach to corporate reorganization, *Harvard Law Rev.* **101,** 775–804.

BERGMAN, Y., AND CALLEN, J. (1991). Opportunistic underinvestment in debt renegotiation and capital structure, *J. Finan. Econ.* **29,** 137–171.

BERLIN, M., AND LOEYS, J. (1988). Bond covenants and delegated monitoring, *J. Finance* **43,** 397–412.

BOLTON, P., AND SCHARFSTEIN, D. (1990). A theory of predation based on agency problems in financial contracting, *Amer. Econ. Rev.* **80,** 93–106.

BRADLEY, M., AND ROSENZWEIG, M. (1992). The untenable case for Chapter 11, *Yale Law Rev.* **101,** 1043–1095.

BREALEY, R., AND MYERS, S. (1991). "Principles of Corporate Finance," Norton, New York.

BULOW J., AND SHOVEN, J. (1978). The Bankruptcy Decision, *Bell J. Econ.* **9,** 437–456.

DETRAGIACHE, E. (1992). "Efficient Resolution of Financial Distress: Does Chapter 11 Help?" Johns Hopkins University Working Paper No. 278.

DIAMOND, D. (1991). Monitoring and reputation: The choice between bank loans and privately placed debt, *J. Polit. Econ.* **99,** 688–721.

EASTERBROOK, F., AND FISCHEL, D. (1991). "The Economic Structure of Corporate Law," Harvard Univ. Press, Cambridge.

EBERHART, A., MOORE, W., AND ROENFELDT, R. (1990). Security pricing and deviations from the absolute priority rule in bankruptcy proceedings, *J. Finance* **45,** 1457–1469.

FRANKS, J., AND TOROUS, W. (1989). An empirical investigation of U.S. firms in reorganization, *J. Finance* **44,** 747–769.

GERTLER, M., AND GILCHRIST, S. (1994). Monetary policy business cycles and the behavior of small manufacturing firms, *Quart. J. Econ.* **109,** 309–340.

GERTNER, R., AND SCHARFSTEIN, D. (1991). A theory of workouts and the effects of reorganization law, *J. Finance* **46,** 1189–1222.

GIBBONS, R. (1988). Learning in equilibrium models of arbitration, *Amer. Econ. Rev.* **78,** 896–912.

GILSON, S. C., JOHN, K., AND LANG, L. H. P. (1990). Troubled debt restructurings, *J. Finan. Econ.* **27,** 315–353.

GORTON, G., AND HAUBRICH, J. (1987). Bank deregulation, credit markets, and the control of capital, *Carnegie–Rochester Conf. Ser. Public Policy* **26,** 289–334.

GORTON, G., AND KAHN, J. (1992). The design of bank loan contracts, collateral, and renegotiation, mimeo, University of Rochester.

GRAHAM, M. (1992). Bankrupt and bullish, *Atlantic Magazine*, March, 24–42.

HART, O., AND MOORE, J. (1989). "Default and Renegotiation: A Dynamic Model of Debt," M.I.T. Working Paper No. 520.

HAUGEN, R., AND SENBET, L. (1978). The insignificance of bankruptcy costs to the theory of the optimal capital structure, *J. Finance* **70,** 383–393.

JENSEN, M., AND MECKLING, J. (1976). Theory of the firm: Managerial behavior, agency costs, and capital structure, *J. Finan. Econ.* **3,** 305–360.

MACKIE-MASON, J. (1990). Do firms care who provides their financing? *in* "Asymmetric Information, Corporate Finance, and Investment" (G. Hubbard Ed.), pp. 63–103. Univ. of Chicago Press, Chicago.

MITCHELL, J. (1990). Managerial discipline, productivity, and bankruptcy in capitalist and socialist economies, *Comp. Econ. Stud.* **22,** 93–197.

MYERS, S. (1977). Determinants of corporate borrowing, *J. Finan. Econ.* **5,** 147–176.

RAJAN, R. (1992). Insiders and outsiders: The choice between informed and arm's-length debt, *J. Finance* **47,** 1367–1400.

SEWARD, J. (1990). Corporate financial policy and the theory of financial intermediation, *J. Finance* **45,** 351–375.

STIGLITZ, J. (1972). Some aspects of the pure theory of corporate finance: Bankruptcies and take-overs, *Bell J. Econ.* **3,** 458–482.

SMITH, C., AND WARNER, J. (1979). On financial contracting: An analysis of bond covenants, *J. Finan. Econ.* **15,** 3–29.

WEISS, L. A. (1990). Bankruptcy resolution. Direct costs and violation of priority of claims, *J. Finan. Econ.* **27,** 285–314.

WHITE, M. (1980). Public policy toward bankruptcy: Me-first and other priority rules, *Bell J. Econ.* **11,** 550–564.

WHITE, M. (1989). The corporate bankruptcy decision, *J. Econ. Perspect.* **3,** 129–151.