THE EFFECT OF CAPITAL STRUCTURE ON A FIRM'S LIQUIDATION DECISION

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A firm's liquidation can impose costs on its customers, workers, and suppliers. An agency relationship between these individuals and the firm exists in that the liquidation decision controlled by the firm (as the agent) affects other individuals (the customers, workers, and suppliers as principals). The analysis in this paper suggests that capital structure can control the incentive/conflict problem of this relationship by serving as a pre-positioning or bonding mechanism. Appropriate selection of capital structure assures that incentives are aligned so that the firm implements the ex-ante value-maximizing liquidation policy.

1. Introduction

The issue of corporate capital structure has been widely debated since Modigliani and Miller (1958, 1963) published their seminal papers. In response to their second work, which implied that in a world with corporate taxes a firm's capital structure consists entirely of debt, researchers looked for debt-related costs, possibly arising from costly contracting, which would admit equity into the capital structure.[1] This paper explores one source of contracting costs which is indirectly related to bankruptcy.

Bankruptcy costs have been used by (among others) Kim (1978), Kraus and Litzenberger (1973), and Scott (1976), to explain the choice of capital structure.

[1]See for example, Baxter (1967), DeAngelo and Masulis (1980), Grossman and Hart (1982), Jensen and Meckling (1976), Kim (1978), Kraus and Litzenberger (1973), Miller (1977), Myers (1977), Ross (1977), Scott (1976). See Chen and Kim (1979) and Titman (1981) for a review of these articles.

The significance of these costs, however, has been disputed by Warner (1977) and Haugen and Senbet (1978). Warner, in a study of bankrupt railroads, finds that the direct costs of bankruptcy are small and concludes that they cannot explain observed capital structures. Haugen and Senbet argue that indirect costs associated with bankruptcy [as suggested by Baxter (1967)] are also unlikely to explain observed capital structures. They point out that these indirect costs are really associated with the firm going out of business, that is, liquidating. By arguing that the firm's bondholders and stockholders agree that the firm should liquidate whenever the liquidation value of the firm is greater than its operating value they conclude that liquidation costs cannot be a factor in the determination of the firm's capital structure.

The Haugen and Senbet paper makes a number of assumptions which are not realistic. First, they assume that the firm makes the liquidation choice that maximizes the total value of the firm's bonds and stock regardless of whether or not the firm is bankrupt. This implicitly assumes that the costs of forming a coalition between stockholders and bondholders are zero. Furthermore, the paper looks only at stockholders and bondholders and thus ignores an important agency relationship between these security holders (as the agents) and other associates of the firm (as principals) who can suffer costs if the firm liquidates.[2] These costs include search and retooling costs for workers and suppliers with job specific capital, and increased expenses for customers.

The model developed in this paper demonstrates that these liquidation costs, along with the conflicting incentives of bondholders and stockholders, have important implications which are relevant to the theory of optimal capital structure.[3] The specific liquidation cost examined in this model is the increased maintenance costs which are borne by the firm's customers. Recent articles in the financial press suggest that observed consumer behavior is consistent with the relevance of these costs. For example, the Wall Street Journal (October 11, 1982) reports that 'the closing of some (International Harvester) dealerships is causing a few customers to worry about getting parts and service'. Lee Iacocca, is quoted as saying that because of Chrysler's need for government loan guarantees, 'its share of new car sales dropped nearly two percentage points because potential buyers feared the company would go bankrupt' (Wall Street Journal, July 23, 1981).

If the customers and other associates of a firm rationally assess its probability of liquidation, the firm will indirectly bear the imposed liquidation costs

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[2] See Jensen and Meckling (1976), Myers (1977), and Ross (1973), for a general discussion of the agency relationship.

[3] For large corporations, very few bankruptcies lead to the total liquidation of the firm. In most cases, the firm is reorganized and continues to operate. However, the reorganized firm may make substantial changes. It may reduce the scale of its operations, drop unprofitable lines of business, and renege on implicit commitments. If the firm's customers, workers, and suppliers suffer costs as a result of these changes, then the reorganization is equivalent to a liquidation for the results that follow.

ex ante. For example, the price a consumer is willing to pay for a durable good declines as the probability of the firm's liquidation increases reflecting the increase in expected maintenance costs. A value-maximizing firm then has an incentive to adopt an enforceable policy of only liquidating in those states of nature where the value of the assets if liquidated exceeds their value if not liquidated by an amount greater than the costs imposed on its customers and other associates. However, this policy is time-inconsistent.[4] Ex post, after the firm has transacted with its customers and associates, an unconstrained value-maximizing firm will want to liquidate as soon as the liquidation value of the assets exceeds their value if not liquidated by any positive amount.

In order to guarantee implementation of its value-maximizing liquidation policy a firm must either accept constraints on its future behavior, or in some other way 'pre-position' or bond itself, to rule out actions which are rational at the future date but detrimental to its value at the current time.[5] Most previous studies which have examined methods of pre-positioning to implement time-inconsistent policies have limited their analyses to explicit contracts such as bond covenants which directly constrain behavior.[6,7] This paper suggests a method of pre-positioning which resolves the time-inconsistency problem through the choice of capital structure, without resorting to explicit constraints.

It is shown here that the capital structure choice affects the stockholders' incentives to liquidate when the firm is not bankrupt. The capital structure choice also determines in which states of nature the liquidation decision is transferred to the bondholders' control (via bankruptcy). Since bondholders have the highest priority claim to the liquidation proceeds they are more likely (than stockholders) to choose to liquidate the firm. Consequently, the capital structure the firm chooses is a determinant of the liquidation policy that it implements. The firm, therefore, by choosing the appropriate capital structure bonds itself to implement the optimal liquidation policy.

[4]A policy which specifies a future action which is consistent with maximization of the decision maker's objective function at the future date is called a time-consistent policy. A policy which does not have this property is time-inconsistent. The first mention of this concept appeared in a paper by Strotz (1956). Kydland (1977) shows that the time-inconsistency problem arises in dominant-player relationships, of which the agency relationship is a special case.

[5]Pre-positioning can be thought of as either a state-dependent bonding activity or as making a state-contingent pre-commitment. See Strotz and Grossman and Hart (1982) for a discussion of pre-commitment.

[6]See for example, Jensen and Meckling (1976), Myers (1977), Smith and Warner (1979) and Strotz (1956).

[7]The exceptions being, Klein, Crawford and Alchian (1978), who discuss the use of vertical integration to resolve a time-inconsistency problem which arises for reasons similar to those discussed here; Jensen and Meckling who hint at methods of pre-positioning using manager compensation and securities other than straight debt and equity; Mayers and Smith (1982) who suggest a bonding role for insurance and Grossman and Hart (1982) who devise a pre-commitment mechanism which also involves a role for capital structure.

If firms cannot issue state-contingent debt claims, they will not, in general, be able to choose capital structures which lead them to exactly implement the unconstrained optimal liquidation policy which was described above. However, this is not crucial for the theory of capital structure suggested by this model. What is important is that a firm's capital structure controls the future liquidation decision and that this, in turn, affects the terms of trade at which the firm does business with its customers, workers, and suppliers. An increase in a firm's debt level, which increases its probability of bankruptcy, will thus worsen these terms of trade to reflect the increased probability of liquidation. These less favorable terms of trade are a cost of debt financing which is relevant to the firm's capital structure decision.

The structure of the paper is as follows. In the next section a partial equilibrium model is presented which demonstrates that the optimal liquidation policy of a firm is generally time-inconsistent. The analysis in section 3 demonstrates that a firm which chooses the appropriate capital structure implements its optimal liquidation policy without using explicit liquidation contracts. The concluding section summarizes the work and discusses the testable implications of the theory.

2. The time-inconsistency of the firm's optimal liquidation policy

In the model which follows, the firm can be viewed from the perspective suggested by Alchian and Demsetz (1972) and Jensen and Meckling (1976); as a nexus for contracting relationships between the firm's different classes of security holders and its customers, workers and suppliers. However, firm value is defined in the more traditional manner as the summed values of its outstanding securities. The analysis which follows demonstrates that a value-maximizing firm's optimal liquidation policy is not, in general, time-consistent. The liquidation policy which maximizes the firm's value in period 0 specifies that the firm should act to maximize the aggregate wealth of all of its associates (including its customers, workers and suppliers) in period 1 rather than just the wealth of its security holders. These objectives are inconsistent whenever any of these outside associates suffer a cost from the firm's liquidation. Although we focus on the costs that liquidation imposes on a firm's customers, the time-inconsistency result follows if any outside associate of the firm has specific human capital or any other form of capital which becomes less valuable as a result of the firm's liquidation.

The model examines a firm which produces a machine that requires maintenance in future periods. Although the combination of the machine and the maintenance (i.e., machine services) are sold in a competitive market, the maintenance for a particular machine may be more cheaply obtained from the producer of the machine. Titman (1981) demonstrates within a general equilibrium model that this will be the case if the production of the machines

and their maintenance (e.g., spare parts) exhibits joint economies of scale.[8] As a result of this, the cost of operating a machine increases if the producer liquidates.

The model has two periods. In period 0 the firm determines its production level and purchases the required quantity of the numeraire good needed for production. The firm utilizes $K(M)$ units of the numeraire good to produce M machines, where $K(M)$ is strictly convex, monotonically increasing and differentiable at all points. The machines are sold at the end of period 0 for use in period 1. In period 1, the firm either produces additional machines, or liquidates its capital, based on which of the N possible states of nature occurs. The firm's period 1 liquidation value is denoted $\delta(\theta_i)K$ in state θ_i, and its operating value in this state is denoted $V_1(\theta_i)$, where V_1 is the value the firm achieves given optimal operating decisions in period 1. The firm's liquidation policy is defined as the function $\rho(\theta_i)$, where $\rho(\theta_i) = 1$ if the firm is to liquidate in state θ_i, and $\rho(\theta_i) = 0$ if the firm plans to continue operating in this state.

Individuals in this economy derive utility from the numeraire good and from machine services. Firms act as price-takers in the sense that the total cost of obtaining the service of a given machine must equal a market determined price. The cost of obtaining this service consists of two components, the purchase price and the maintenance costs, which can differ across firms. If the machines produced by one firm cost more to operate than the machines produced by another firm, then the machines with the higher operating costs must sell for less than the machines with the lower operating costs by an amount equal to the difference in the discounted cost of operating these machines over their lives. For this reason, a firm's products will fall in value, by an amount equal to the present value of the increase in their operating cost, if the firm chooses to liquidate. If the firm chooses to liquidate in state θ_i [i.e., $\delta(\theta_i) = 1$], the machines will be worth $P[1, \theta_i]$. If however the firm chooses not to liquidate in this state [i.e., $\delta(\theta_i) = 0$], the machines will be worth $P[0, \theta_i]$, where $P[0, \theta_i] - P[1, \theta_i] = c(\theta_i)$, the cost imposed by the liquidation.

Since the value of a machine in period 1 is affected by whether or not the producer liquidates, the price that a firm's machines sell for in period 0 will reflect the firm's liquidation policy. If a complete market for state-contingent claims exists, and individuals know the price of machines in the future states, the period 0 selling price of machines, $P_0(\rho)$, can be expressed as the sum of their period 1 state-determined prices discounted by $p(\theta_i)$, the period 0

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[8]The price of maintenance will be determined by the marginal producer. Thus, with joint economies of scale in producing the machines and their maintenance, the manufacturer of the machines is an intramarginal producer of replacement parts. The liquidation of this firm raises the cost of maintenance by the difference in the costs of the marginal supplier after versus before liquidation. Depending on their production functions, this difference in cost may either be large or small.

forward price for one unit of the numeraire good in state θ_i,

$$P_0(\rho) = \sum_{i=1}^{N} P[\rho(\theta_i), \theta_i] \, p(\theta_i). \tag{1}$$

The firm's period 0 value is equal to its period 0 cash flow $[P_0(\rho)M - K(M)]$ plus the sum of its state-determined period 1 values discounted by $p(\theta_i)$. The period 1 value of the firm will be its liquidation value $[\delta(\theta_i)K(M)]$ in states of nature in which $\rho(\theta_i) = 1$ (i.e., its policy specifies liquidation) and it will be its operating value $[V_1(\theta_i)]$ in states of nature in which $\rho(\theta_i) = 0$. The assumptions of complete and competitive markets are consistent with the notion that value-maximization is the firm's goal in period 0. The following maximization problem assumes that the firm makes its production decision, as well as its period 1 liquidation policy, in period 0,

$$\max_{\{\rho, M\}} V_0 = P_0(\rho)M - K(M)$$

$$+ \sum_{i=1}^{N} [\delta(\theta_i)K(M)\rho(\theta_i) + V_1(\theta_i)(1 - \rho(\theta_i))] \, p(\theta_i). \tag{2}$$

Given the convexity of $K(\ )$, an M^* exists which maximizes (2). The optimal liquidation policy $\rho(\theta_i)$ can then be found by substituting (1) into (2) and comparing the incremental increase in period 0 value for $\rho(\theta_i) = 1$ with the increase in value for $\rho(\theta_i) = 0$ for each state of nature. This comparison is expressed by the following inequality which demonstrates that the firm should liquidate in those states of nature and only those states in which

$$P[1, \theta_i]M^* + \delta(\theta_i)K(M^*) > P[0, \theta_i]M^* + V_1(\theta_i), \tag{3a}$$

which reduces to

$$\delta(\theta_i)K(M^*) - C(\theta_i) > V_1(\theta_i), \tag{3b}$$

where

$$C(\theta_i) = c(\theta_i)M^* = P[0, \theta_i]M^* - P[1, \theta_i]M^*.$$

The preceding analysis suggests that ex ante, before the machines are sold, a value-maximizing firm should adopt a policy of only liquidating in states of nature where the liquidating value of its assets exceeds their operating value by an amount greater than the costs imposed on its customers. The importance of the assumption that the period 1 liquidation choice was determined in period 0 can be appreciated given this result. If the firm does not prespecify the period 1

liquidation conditions in period 0, it will liquidate whenever its liquidating value exceeds its operating value. The consumers will rationally forecast this liquidation policy reflecting it in their demand prices for the machines. This will make the value of the firm lower. This creates an incentive for firms to either impose constraints on themselves or in some other way pre-position themselves so that the ex ante value-maximizing policies rather than the ex post value-maximizing decisions are made in the future.

Implementing the optimal liquidation policy would be straightforward if it were costless to write and enforce state-contingent contracts. Contracts between the firm's bondholders and stockholders would then specify that stockholders make decisions which maximize the total value of the bonds and stock. The stockholders, in turn, would write contracts with its customers which either describe conditions (i.e., states of nature) under which liquidation is permitted or, alternatively, would specify a state-contingent penalty which the firm pays its customers if it liquidates. However, in many instances state-contingent contracts are expensive to negotiate, administer, and enforce. In such instances, firms must use indirect methods of pre-positioning to implement their optimal liquidation policy. One such method is examined below.

3. Pre-positioning with capital structure

The analysis which follows assumes that the firm is controlled by wealth maximizing equityholders as long as the firm is not bankrupt.[9] If the firm becomes bankrupt, control passes to its bondholders who seek to maximize their wealth. The analysis in the last section suggests that the equity holders of such a firm have an incentive to enter into contracts which force it to make period 1 decisions which maximize the combined wealth of its bondholders, stockholders, and its customers. The cost of any deviation from such a policy will be reflected in the prices of the firm's bonds and its products and will thus be borne by the equity holders. The relevant problem facing the equity holders is then to enter into contracts with the firm's bondholders and customers which lead it to implement the optimal liquidation policy.

Writing and enforcing contracts which lead the firm to implement the optimal liquidation policy becomes especially costly when the bonds are issued before the firm's products are sold. In this case, if contracts with the bondholders do not specify otherwise, equity holders will enter into contracts with their customers which exporpriate wealth from the bondholders and lead the

[9]Jensen and Meckling (among others) have pointed out that the equity holders will not, in this case, always act to maximize the total value of the firm. However, Fama (1978) argues that firms which are subject to outside takeover must maximize total value. Grossman and Hart (1980) suggested that because of transaction costs and a free-rider problem, non-value-maximizing firms can continue to exist without offering any individual an opportunity for a profitable takeover. Titman (1981) demonstrated that this is the case even when the firm's liquidation value exceeds its operating value.

firm to liquidate in fewer states of nature than would be prescribed by the optimal policy. This can easily be seen for the case where the liquidation claim of the firm's senior securities exceeds its liquidation value. In this case, the equity holders will either offer the firm's customers excessive reimbursement payments for their liquidation costs or alternatively enter into contracts which preclude liquidation. Equity holders lose nothing from such contracts, because they stand to receive nothing from the firm's liquidation proceeds, but they gain by offering these contracts since it allows the firm to charge higher prices for its products.

The preceding discussion suggests that a firm which is sufficiently levered implements the optimal liquidation policy only if both bondholders and customers engage in contracts with the equity holders. The contracts with customers are needed to insure that the firm does not liquidate in states of nature not specified by the optimal policy. The contracts with bondholders are needed to prevent the firm from agreeing to continue operations in states of nature in which the optimal policy prescribes liquidation.

In the absence of contracting costs the number of contracts needed to implement a given policy is irrelevant. However, contracting costs are significant and firms have an incentive to structure a cost-minimizing set. The analysis which follows suggests that under certain conditions firms can eliminate the need for customer contracts by choosing the appropriate capital structure.

The analysis abstracts from the many facets of a firm's capital structure decision and examines it as one of optimally choosing two different contracts. One contract specifies the states of nature in which the firm is bankrupt, and hence controlled by its bondholders. The other contract specifies the payoff to each class of security holders in the event that the firm liquidates.[10] It is assumed in this section that equity holders have the lowest priority claim in the event of liquidation. In other words, bondholders and preferred stockholders must receive their liquidating claims, D and Pf respectively, before the equity holders can receive anything. If $D + Pf$ is greater than the liquidation value δK, then the bondholders' claims have priority over the claims of the preferred stockholders.

In contrast to the Haugen and Senbet model, bondholders and stockholders in this model do not always agree on whether or not the firm should liquidate. Stockholders have a stronger preference for continuing to operate the firm since they have the lowest priority claim to the liquidation proceeds, and bondholders tend to prefer liquidation since they have the highest priority claim to t'·e liquidation proceeds. This conflict between the different sets of security holders allows the firm to use capital structure contracts to pre-position itself to implement a specific liquidation policy.

[10] This contract stipulates payoffs which are contingent on the firm liquidating its line of business, not on the firm going out of business. Changing lines of business without repaying the senior claimants would, therefore, constitute a default of the second contract. Smith and Warner (1979) suggest that bond covenants of this type are fairly standard.

The relation between the capital structure which is chosen and the liquidation policy which is subsequently implemented is fairly straightforward. Increasing the face value of the firm's debt or preferred stock decreases the liquidation proceeds which go to the equity holders and hence reduces the number of states of nature in which equity holders will choose to liquidate the firm. If the face value of the debt and preferred stock exceeds the liquidation value of the firm in all states of nature, the equity holders receive nothing in the event of liquidation, and thus never choose this alternative. But in this case, if the firm's liquidation value exceeds its operating value, bondholders prefer to liquidate the firm. The states of nature in which the firm liquidates are then determined by the states in which bondholders have control of the firm, that is, in those states where the firm is bankrupt.

The principal contribution of this paper is contained in the following propositions. Proposition 1 establishes conditions on the firm's capital structure contract, which if satisfied, lead the firm to implement its optimal liquidation policy. These conditions may appear to be rather complex, and they may in general be difficult to satisfy. However, as Proposition 2 demonstrates, under simplifying conditions these sufficient conditions are satisfied by a rather straightforward capital structure.

Proposition 1. A firm will liquidate according to its optimal policy if its capital structure contracts are chosen so that

(1) *it is bankrupt in all those states of nature and only those states of nature in which*

$$V_1(\theta_i) < \delta(\theta_i)K - C(\theta_i),$$

(2) $D \geq \delta(\theta_i)K - C(\theta_i)$ *whenever the firm is bankrupt, and*
(3) $Pf + D \geq \delta(\theta_i)K, \forall \theta_i.$

Proof. Condition (1) states that the firm is bankrupt in all those states of nature and only those states of nature in which liquidation is prescribed by the optimal policy. The second condition guarantees that the debt holders strongly prefer liquidation over continuing to operate the firm. The third condition implies that the equity holders' share of the liquidation proceeds must always be zero. These conditions indicate that equity holders never choose to liquidate in the states of nature in which they control the firm, and that bondholders always choose to liquidate the firm when it is bankrupt. Since the firm is bankrupt in all those states of nature, and only those states of nature in which liquidation is prescribed by the optimal policy, the proposition is proved. □

It should be noted that the conditions specified in the above proposition are sufficient, but are not necessary. Condition (2) will not be needed if we make the alternative assumption that debt holders choose to liquidate the firm if they

arc indifferent between liquidation and continuing to operate the firm but preferred stockholders prefer the liquidation alternative. Condition (3) can be weakened to allow equity holders a share of the liquidation proceeds in some states of nature as long as that share is not large enough to induce shareholders to liquidate the firm.

Preferred stock is included in this analysis because in certain cases conditions (1) and (3) cannot be satisfied simultaneously using only debt and common equity. For instance, it is not always possible to set the liquidating claims of the debt above the firm's liquidation value without causing the firm to be bankrupt in more states of nature than are specified in condition (1). By issuing preferred stock, the firm can eliminate the common stockholders' incentive to liquidate the firm without causing the firm to be bankrupt in additional states of nature.

It should be noted, however, that condition (1) can require fairly complex bankruptcy contracts. The complexity arises since the liquidating value of the firm, net of the costs imposed (i.e., $\delta K - C$), can exceed its operating value in some states of nature in which operating value is relatively high, but may be lower than its operating value in some states of nature in which operating value is relatively low. Hence, condition (1) of the above proposition cannot in general be satisfied by selecting a debt level D^* and specifying that the firm is bankrupt whenever $V_1(\theta_i) < D^*$.

The example illustrated in fig. 1 demonstrates this point. If the firm's period 1 debt obligation is less than D', it will not be bankrupt, and subsequently not
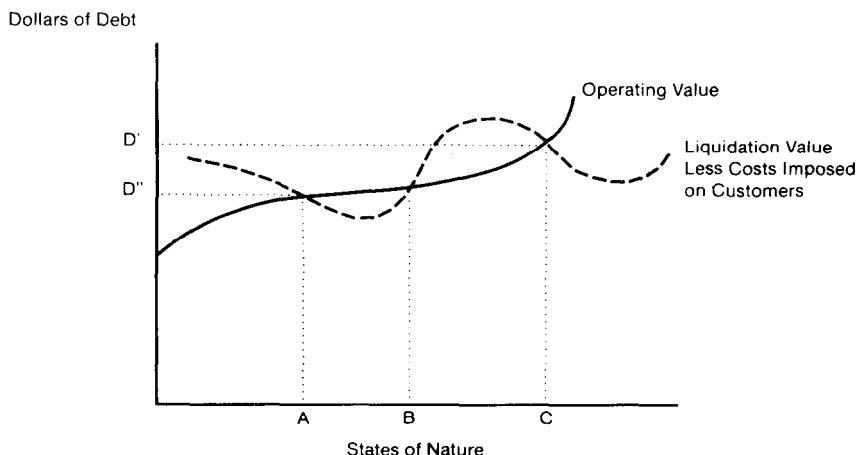

Fig. 1. The operating value of the firm ($V_1(\theta_i)$) and its liquidation value less the costs imposed on its customers $[\delta(\theta_i)K(M^*) - C(\theta_i)]$ are plotted against the state of nature θ_i, where θ_i is ordered so that $V_1(\theta_i)$ is a monotonically increasing function. This figure illustrates the case where these two values intersect twice, implying that for the relatively low operating values in the region AB, $V_1(\theta_l) > \delta(\theta_l)K(M^*) - C(\theta_l)$, and for the higher operating values in the region BC, $V_1(\theta_h) < \delta(\theta_h)K(M^*) - C(\theta_h)$. Since $V_1(\theta_h) > V_1(\theta_l)$, the firm cannot implement the optimal liquidation policy by selecting a debt level D^* and specifying that the firm is bankrupt whenever $V_1(\theta_i) < D^*$.
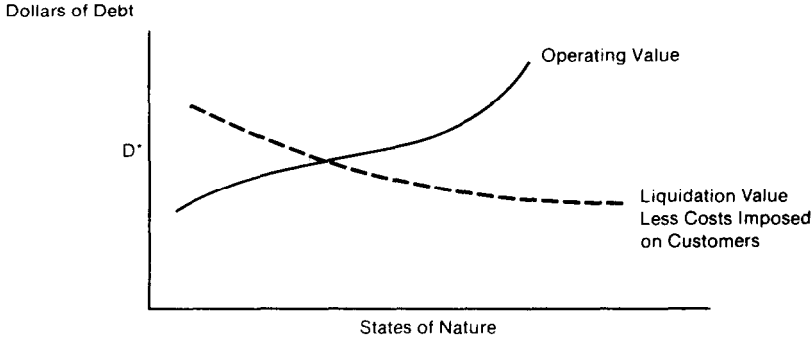
Dollars of Debt

Fig. 2. As in fig. 1, the operating value of the firm ($V_1(\theta_i)$) and its liquidation value less the costs imposed on its customers $[\delta(\theta_i)K(M^*) - C(\theta_i)]$ are plotted against the state of nature θ_i, where θ_i is order so that $V_1(\theta_i)$ is a monotonically increasing function. This figure illustrates the case where these two values intersect only once. In this case the firm can implement its optimal liquidation policy by choosing a debt level D^* which equals the firm's operating value at the point of intersection and specifying that the firm is bankrupt whenever $V_1(\theta_i) < D^*$.

liquidating, in all states of nature in which $V_1(\theta_i) < \delta(\theta_i)K(M^*) - C(\theta_i)$. Conversely, if the firm's debt obligation exceeds D'', it will be bankrupt, and subsequently liquidating, in some period 1 states of nature in which $V_1(\theta_i) > \delta(\theta_i)K(M^*) - C(\theta_i)$. Since D' exceeds D'', no state-independent debt obligation will lead the firm to implement its optimal liquidation policy.

In reality, firms can at least partially determine the states of nature in which they will be bankrupt by properly selecting the maturity and seniority structure of their debt and by writing the appropriate bond covenants.[11] In general, it would be prohibitively costly to write capital structure contracts which exactly implement the optimal policy. Nevertheless, since the capital structure does determine the firm's liquidation policy, that structure which implements the best of the feasible policies will be chosen. Capital structure will, in this case, only partially resolve the time-inconsistency problem.

Under certain conditions, very simple capital structure contracts implement the optimal liquidation policy. If one could say, for instance, that $V_1(\theta_i) - \delta(\theta_i)K(M^*) + C(\theta_i)$ is positive in all states of nature in which V_1 exceeds some $\hat{V}$ and is negative in all states in which V_1 is less than $\hat{V}$, the conditions in

[11]An article by Bulow and Shoven (1978) discusses how the mix between short-term and long-term debt and the priority of these claims affect whether or not a firm becomes bankrupt in a particular state of nature. They demonstrate that a bank which holds a substantial portion of a firm's short-term loans will either renew the loans and prevent bankruptcy or call in the loans forcing the firm into default depending on, among other things, the relative size of the loan and its priority in the event of bankruptcy. Smith and Warner (1979), in the context of a problem much different than the one examined in this paper, discuss the use of various types of bond covenants. These covenants allow the firm to predetermine the states of nature in which it is in default for reasons other than the non-payment of the interest or the principle on its debt.

the previous proposition are satisfied by a very simple capital structure contract. In this case, condition (1) of the previous proposition is satisfied if D equals $\hat{V}$ and bankruptcy occurs whenever V_1 is less than D. This point is illustrated in the following proposition and in fig. 2.

Proposition 2.   If δK and C are constant across states of nature and bankruptcy occurs whenever the firm's operating value falls below its debt obligations, the firm will liquidate according to its optimal policy if it

(a)   *issues short term debt which matures in period 1 with a maturity value equal to $\delta K - C$, and*

(2)   *issues preferred stock in an amount where $Pf \geq C$.*

Proof.   The reader can easily verify that the above capital structure satisfies conditions (1) and (2) from the previous proposition. The firm, therefore, implements its optimal liquidation policy.   □

The particular capital structure described in the preceding proposition is not necessarily the only one which implements the optimal liquidation policy; perhaps long-term debt can be substituted for the firm's preferred stock.[12] The capital structure was chosen for its simplicity rather than its realism. The proposition demonstrates that under certain conditions, a firm can guarantee implementation of its value-maximizing liquidation policy without using state-contingent contracts.

It should be noted that both under the simplifying assumptions of Proposition 2 and the more general assumption of Proposition 1, that the capital structure method for pre-positioning uses fewer contracts than the alternative involving liquidation contracts with customers, and is thus probably less expensive to enact. If this is actually the case, then the preceding analysis provides a positive theory of capital structure which accounts for the use of debt, equity, and possibly preferred stock. An important and potentially testable implication of this theory is that, ceteris paribus, firms which impose relatively large costs on their customers in the event of liquidation, and thus wish to pre-position so that they liquidate in only a few states of nature, choose low levels of debt which lead them to be bankrupt in only those few states of nature.[13]

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[12] In this simplified example, the optimal liquidation policy will also be implemented with a capital structure consisting of short-term debt with a maturity value equal to $\delta K - C$, and subordinated long-term debt with a liquidation claim equal to C. It would be misleading to present this result without also determining the consequences of a dynamic process in which long-term debt eventually becomes short-term debt. The two period model presented in this paper is incapable of discerning these consequences.

[13] This assumes that the number of states in which a firm is bankrupt is a monotonically increasing function of its debt level. This assumption seems intuitively correct, but the reader should be aware of the discussion in Miller (1977) regarding income bonds for a dissenting opinion.

The role of bankruptcy in this theory can be viewed within the context of more traditional theories of capital structure which assume that bankruptcy is costly. Bankruptcy is costly in this model if the firm issues more debt and subsequently goes bankrupt and then liquidates in states of nature in which liquidation is inconsistent with its optimal policy.[14] The cost of being bankrupt and then liquidating in a state not prescribed by the firm's optimal policy is the difference between its operating value and its liquidation value net of the costs imposed on its customers. The firm bears this cost, in the form of lower prices for its products, in period 0. Bankruptcy in an additional period 1 state θ_i will thus lower a firm's period 0 value by the following amount if it affects its liquidation decision. This can be obtained from eqs. (1) and (2) in section 2,

$$BC(\theta_i) = \left[V_1(\theta_i) - \delta(\theta_i)K + C(\theta_i) \right] p(\theta_i). \tag{4}$$

4. Conclusion

This paper examines an agency relationship between a firm (as the agent) and its customers (as principals) who suffer costs if the firm liquidates. It is shown that the firm indirectly bears the liquidation costs which it imposes on its customers in future states of nature in the form of lower prices for its products in the current period. Because of this, the liquidation policy which maximizes a firm's current value takes into account the costs which it imposes on its customers in the future if it liquidates. However, an unconstrained value-maximizing firm will not carry out this policy in the future period but will instead choose to liquidate whenever its liquidation value exceeds its operating value.

The firm's capital structure choice was shown to provide a method by which the firm can pre-position or bond itself so that the optimal liquidation policy is implemented. Appropriate selection of capital structure assures that equity holders continue to operate the firm when it is not bankrupt, and that the firm is bankrupt and controlled by bondholders who choose to liquidate the firm in those states of nature, and only those states, in which liquidation is consistent with the optimal policy.

The analysis in this paper ignored other factors such as other types of agency costs, direct bankruptcy costs, and taxes which influence a firm's capital structure choice. These factors cause the firm to choose a different capital structure than would be optimal from the consideration of the above liquidation policy incentives alone. A tax gain from leveraging, for example, causes the firm to issue additional debt, and hence go bankrupt in states of nature in which

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[14]A bankrupt firm will not always choose to liquidate. A firm which is bankrupt in a state of nature in which $V_1 > \delta K$ will not liquidate and hence will not suffer these liquidation related bankruptcy costs in this state.

liquidation is not prescribed by the above policy. Bankruptcy in these additional states of nature will be costly since it either leads the firm to implement a suboptimal liquidation policy or alternatively, forces the firm to write additional contracts with its customers. These costs must be considered along with the other costs and benefits of debt financing in the choice of the firm's optimal capital structure.

The developed theory of optimal capital structure has potentially testable cross-sectional implications. It predicts which firms should be highly levered and which should lever very little. According to the theory, firms (such as computer and automobile companies) which can potentially impose high costs on their customers and business associates in the event that they liquidate choose capital structures with relatively low debt/equity ratios. Conversely, firm (such as hotels and retail establishments) which impose relatively low costs on their customers and business associates in the event that they liquidate choose high debt/equity ratios.

There is very little published empirical work in the area of optimal capital structure. This probability reflects the absence of testable hypotheses generated from prior theoretical work in this area. Schwartz and Aronson (1967), Scott (1973), and Scott and Martin (1975), found that industry groupings explained a statistically significant proportion of the variance of observed capital structures. This finding is consistent with the theory suggested in this paper but is also consistent with almost any theory of capital structure imaginable. Clearly, additional empirical research on this subject is needed.

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