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Callable Bonds: A Risk-Reducing Signalling Mechanism

EDWARD HENRY ROBBINS and JOHN D. SCHATZBERG*

ABSTRACT

The theory of financial economics has failed to distinguish advantages of callable bonds from those of short-term debt. This paper shows that either type of borrowing can signal a firm's better prospects but that short-term debt does so at the cost of weakened risk-sharing with capital markets. By issuing either equity or long-term, non-callable debt, a firm with poor investment opportunities will not pool its prospects with those of a better firm. But equity produces superior risk-sharing. Perhaps this explains the almost complete absence of long-term, non-callable bonds from observed corporate capital structures.

FINANCIAL THEORY HAS FOUND only moderate success in explaining the routine inclusion of call provisions among the covenants of corporate bonds. In the absence of market imperfections or incompleteness, the incremental compensation promised to bondholders should exactly offset the value of the call provision retained by equityholders. *Indifference* should obtain.[1] Nevertheless, it is hard to accept indifference as an explanation, given the near universality of call provisions in corporate bond contracts.

In this paper, we argue that, in the presence of asymmetric information about investment quality, corporate managers can signal their firm's better prospects by issuing bonds that include call provisions. Our major result shows that this signalling mechanism can be *more attractive to risk-averse managers* than would be the choice of short-term debt (which could also serve to signal). Furthermore, we demonstrate that non-callable corporate debt is a dominated security. That is, both it and equity signal "Bad News," but equity provides risk-sharing. This finding helps to explain the relative absence of long-term, non-callable debt from corporate financial markets.

Previous attempts to explain the prevalence of call provisions in corporate bond contracts fall into four categories. Two categories involve pure wealth transfers from bondholders to stockholders. In these constant sum environments, a gain to one group constitutes a loss to the other. In the first category, managers possess private information with regard to future interest rate movements. Issuing callable bonds will capture gains for stockholders when anticipated drops

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[1] See Pye [20] and Bodie and Friedman [3].

in interest rates are later realized. The second category constitutes arguments that callability allows hedging against interest rate risk. Both Myers [17] and Bodie and Taggart (hereafter, BT) [4] have questioned the "ad hoc" nature of the assumptions inherent in the arguments of both these categories. Moreover, Myers [17] suggested that, in the constant-sum environment, there is little reason for management to "play the game" unless they possess special knowledge about future interest rates. He concluded that there may be other, unspecified motivations—apart from interest cost—for routine inclusion of call provisions in corporate debt contracts.

The remaining two categories rely upon non-constant-sum mechanisms: the total value of the firm is increased. In the third category, this goal is accomplished by introducing yet another party (the federal government) to the game and then forcing a wealth transfer from that new player. Marshall and Yawitz [16] and Yawitz and Anderson [23] attribute the prevalence of the call feature to asymmetries[2] in the United States tax laws. In contrast, Brick and Wallingford [6] contend that repurchase of non-callable bonds might yield even superior tax gains. They conclude that tax effects alone are insufficient to explain the routine inclusion of the call feature in corporate debt contracts.

Within the fourth category, callable bonds dissipate certain agency costs of debt. BT [4] suggest that profitable future investments might not be undertaken if the entire gain were to be captured by existing bondholders (in the form of lower bankruptcy risk).[3] Barnea, Haugen, and Senbet (hereafter, BHS) [2] extended BT's work by considering stockholder risk incentives under informational asymmetry as another agency problem that could be solved by inclusion of call provisions.

The essential feature of call provisions within agency costs arguments is their ability to permit recontracting prior to expiration of comparable long-term, non-callable debt. This potential for recontracting allows stockholders to benefit directly from "positive" state realizations. Benefit takes the form of lower promised payments to creditors. However, neither BT [4] nor BHS [2] succeeded in showing any advantage of callable bonds over short-term debt, since the latter also allows recontracting at a later date (Myers [18]).

In Section I, we develop a simple example analogous to that appearing in BT [4]. In the manner of BHS [2], we assume insider information among the firm's managers. Additionally, we identify the form of optimal managerial compensation and its implications for optimal operation of the firm. These contracts provide *indirect* incentives for managers to signal the better prospects of their firm, when such prospects arise. In our example, issuing either callable bonds or short-term debt proves to be an effective mechanism for signalling good prospects. Both equity and long-term, non-callable bonds are "separated" as potential signals of "Bad News."

[2] Upon call of a bond, the call premium received by the lender is taxed at capital gains rates. But the premium paid by the borrower is deducted at ordinary income rates. Hence, whenever the borrower's ordinary income tax rate exceeds the lender's capital gains rate, a tax incentive exists to call the bonds. Anticipation of the possibility of gaining in case of call induces the issuance of callable bonds.

[3] Their argument was later clarified by Aivazian and Callen [1] and BT [5].

In Section II, we are led to ask the question: *What causes the commonplace preference for callable bonds over short-term debt*? Our answer: By choosing to issue the former, managers can reduce the risk to their compensation at the same time that they succeed in signalling their firm's better prospects.[4] Likewise, when inside information indicates poorer prospects for the firm, managers will choose to issue equity over long-term, non-callable debt because doing so reduces risk to their own compensation. Section III summarizes and concludes the paper.

I. The Example

Our example contains a capital market for primary securities offerings, a firm, and the manager of that firm. Four time periods (respectively, $t = 0$, $t = 1$, $t = 2$, and $t = 3$) occur sequentially. In time period $t = 0$, the firm's owners—who are members of the capital market—establish a compensation contract for the manager. Later, at times $t = 1$ and $t = 2$, participants in the capital market receive endowments of capital and invest them. And if, at time $t = 2$, investors receive distributions from the investments they made at time $t = 1$, they reinvest those proceeds until time $t = 3$. Other than the investment opportunities of the firm upon which we focus, all investments in the economy are riskless constant-returns-to-scale storage technologies.

Investment is undertaken in order to provide for investors' (sole) consumption at time $t = 3$. Over that consumption, they display risk neutrality. For simplicity of presentation and to underscore the fact that our example entails no private information regarding macroeconomic interest rates, we assume that market interest rates from $t = 1$ to $t = 2$ and from $t = 2$ to $t = 3$ are both fixed at zero.[5]

The firm's prospects and the times at which those prospects become known to the players are displayed in Figure 1. At time $t = 1$, the manager privately observes that the firm has either "Good News" (G) or "Bad News" (B). (These labels prove justifiable, given the prospects from Figure 1 and the market pricing that we have described. "Good News" leads to an expected liquidation value of \$6.00 if the project is carried out. The expected liquidation value of the project is \$17/3 under "Bad News." Furthermore, the firm's project will prove to be of positive net present value, under either information realization.) *Ex ante*, each type of news is equally likely.

The firm's manager next organizes a primary offering to the capital market. We assume that only four types of securities contracts are admissible: long-term, non-callable bonds; long-term, callable bonds; short-term debt; or additional equity. In particular, we assume that the manager cannot write securities contracts whose payments are contingent upon the later public revelation of his or her knowledge regarding the quality of the firm's investment prospects.[6] Nor can

[4] The importance of signalling *through least costly mechanisms* was recognized in Ross [22].

[5] This could represent several cases of interest. One, in particular, is the possibility that macroeconomic interest rates remain constant throughout and that the payoffs that we identify in our example are stated in net-present-value terms.

[6] Although this assumption may trouble those readers well versed in the theory of optimal contracting (see, e.g., Holmstrom [9]), it remains consistent with that part of the finance literature we here seek to address. It is, in particular, representative of an attempt to infer reasons for the

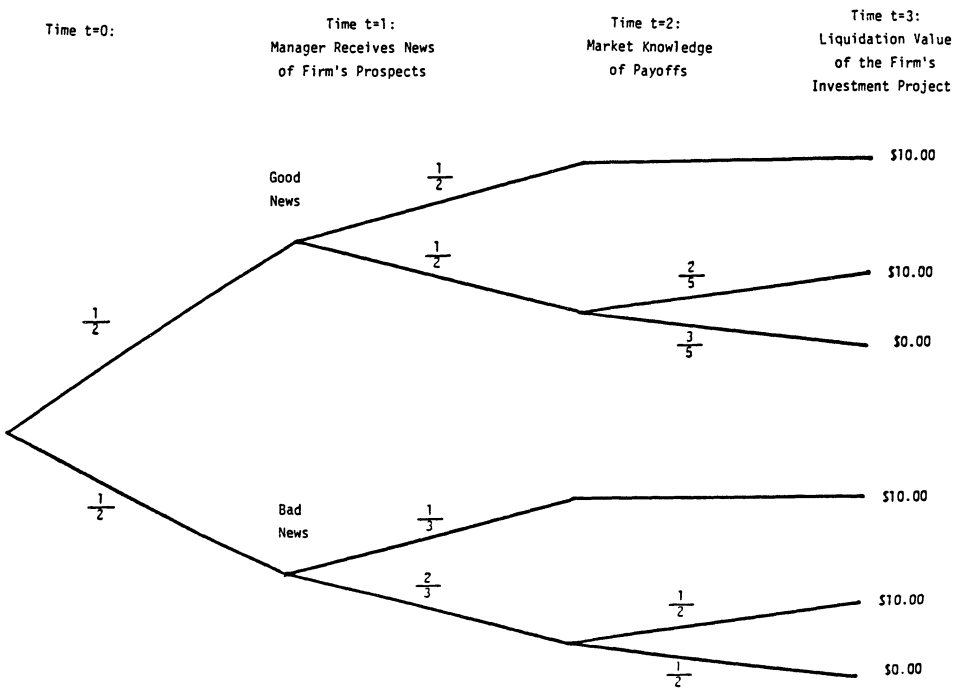

Figure 1. The Decision Tree of Events

the manager credibly "announce" his or her private information, e.g., because doing so would make public so much company-private information that the manager would sacrifice the added value of an investment opportunity of either type.

The manager then invests the capital he or she raises. Exactly \$1.00 of that capital is required for the firm's project. Any capital raised beyond that requirement will be invested in market opportunities. If any less than \$1.00 is raised, that amount must be invested in the market. To underscore the fact that our example entails no question of the avoidance of agency costs of debt, the manager has available no production decision other than this initial decision of whether or not to invest.

Let us suppose that the manager succeeds in raising at least \$1.00. Under either information condition, the firm's project constitutes a first-stage lottery between exactly two second-stage "lotteries." And at time $t = 2$, the exact second-stage lottery to be faced by the firm will become known both to the manager and to the capital market. One second-stage "lottery" is the certain payment (at time $t = 3$) of \$10.00. This "lottery" occurs with probability ½ if the manager has "Good News" at time $t = 1$ or with probability ⅓ if he or she has "Bad News."

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prevalence of *observed* financial contractual forms rather than to "rationalize" that such problems are not important because they could easily be handled by contractual forms that are, in fact, not actually employed in financial institutional settings. Thus, in a sense, we do not seek an optimal contract. Rather, our goal is to make relative comparisons among standard contractual forms.

The alternative second-stage lottery depends upon the manager's news at time $t = 1$. If that news is Good, the alternative second-stage lottery pays \$10.00 with probability ⅖ and \$0.00, otherwise. On the other hand, if the manager's news is Bad, the second-stage lottery pays those same amounts, but in an equally likely manner.

A. Managerial Preferences, Compensation, and Consequent Decision-Making

Next, we describe the decision-making process that will be pursued by the firm's manager. Our first step is to describe his or her preferences. We assume the manager to possess a utility function over consumptions at dates $t = 0$, $t = 1$, $t = 2$, and $t = 3$ that is additively separable across consumptions at different dates:

$$U[c_0, c_1, c_2, c_3] = U_0[c_0] + U_1[c_1] + U_2[c_2] + U_3[c_3] \tag{1}$$

Further, we suppose that each component by itself is an increasing, risk-averse von Neumann-Morgenstern utility function. Finally, let us assume that component $U_3[\cdot]$ is thrice continuously differentiable with bounded third derivative. (These assumptions were taken by Pratt [19] and, therefore, allow us to employ particular implications of his results on "local risk aversion.")

Whence derives the manager's consumption? We assume him or her to have no other source than the compensation paid by the firm's owners.[7] Those employers will solve an optimal managerial compensation program (see, e.g., Ross [21], Holmstrom [9], and Lambert [14] for discussion of solution techniques for optimal compensation contracts in a variety of Principal-Agent problems). Because owners are risk-neutral, they will seek to minimize the manager's expected compensation, subject to satisfying his or her reservation utility constraints at times $t = 0$, $t = 1$, $t = 2$, and $t = 3$, and subject to the requirement that they motivate that manager to be concerned with[8] the time $t = 3$ liquidation value of the firm.

Let us suppose that compensation contracts are not (directly) "rigged" either to obtain our goal of displaying signalling through a particular form of capital structure or to refute it by inducing information revelation via some other mechanism. (In the former case, we forbid compensation contingent upon rules such as, "If the firm turns out to have had Good News and the manager issues callable debt, then . . . " And in the latter, we reject rules such as, "If the firm turns out to have had Good News and the manager publicly announces it to have

[7] Thus, in part, we assume that the manager is forbidden to trade in securities markets. This prevents each of two possibilities: first, that his or her incentives might deviate substantially from those we shall assert here; and second, that the process of signalling through choice of capital structure could be disrupted because markets are able to infer the manager's information by observing his or her insider trading (see Jaffe [12]).

[8] It is traditional in Principal-Agent theory to assume a "Principle of Non-Malevolence." (We thank John Roberts, of Stanford University, for discussions on this point.) That is, if the Agent finds that multiple actions attain his or her maximum, traditional economics anticipates that he or she will select that action best for the Principal. We take an alternative assumption in our discussion. Instead, we assume that owners must motivate the manager to fulfill their goals. They cannot simply award him or her compensation and hope that he or she will do so.

had Good News, then ...") More specifically, we suppose that compensation may only be made contingent upon the time $t = 3$ liquidation value of equity, $\tilde{L}_3$. Then, the optimal compensation contract will closely resemble a contract taking the following form:

(i) constant compensation, s_0, at time $t = 0$;
(ii) constant compensation, s_1, at time $t = 1$;
(iii) constant compensation, s_2, at time $t = 2$; and
(iv) compensation only slightly dependent upon the time $t = 3$ state:

$$s_3(\tilde{L}_3) = C + \varepsilon\tilde{L}_3 \tag{2}$$

where $\tilde{L}_3$ is the liquidation value of equityholders' share of the firm at time $t = 3$ and ε is some tiny positive number. The first three components of compensation will not influence managerial decision making. The fourth clearly will.

First, the manager will maximize the expected liquidation value to be obtained by equityholders at time $t = 3$. To see this, note that Pratt's [19] description of tiny gambles approximates our situation. And since our assumption of third order differentiability of U_3 implies that the second derivative is bounded, we may use Taylor series methodology to expand about C:

$$\begin{aligned} E[U_3(C + \varepsilon\tilde{L}_3)] &= E[U_3(C) + \varepsilon\tilde{L}_3U_3'(C) + \tfrac{1}{2}(\varepsilon\tilde{L}_3)^2U_3''(C) + 0[(\varepsilon\tilde{L}_3)^3]] \\ &= U_3(C) + \varepsilon U_3'(C)E(\tilde{L}_3) + \tfrac{1}{2}\,\varepsilon^2U_3''(C)E[(\tilde{L}_3)^2] + \varepsilon^2\mathrm{o}[E[(\tilde{L}_3)^2]]. \end{aligned} \tag{3}$$

Provided that ε is sufficiently small, this will dictate that maximization of the expected time $t = 3$ liquidation value of the firm will constitute first-order effects of managerial decision making. That is, when analyzing capital structure decisions of the firm, we can conclude that the first consideration taken by the firm's manager will be the impact upon the expected time $t = 3$ liquidation value of equity. And because he or she has that goal, equityholders have no incentive to provide further controls to the manager's decision making. They are indifferent among his or her alternative choices of action.

We also anticipate *second-order effects* to managerial decision making. Second-order effects arise because the manager's compensation contract does not leave *the manager* indifferent among the choices to which owners are indifferent. Our anticipated second-order effect is the display of risk aversion with respect to the random liquidation value of equity, L_3, to be obtained at time $t = 3$. To see this, once again return to Equation (3). The manager is limited to the set of choices for which expected liquidation value is maximized. Among such choices, the second-moment consequences of his or her decision making will take precedence. Because $U_3''[C]$ is negative, the manager will minimize those consequences. We shall approximate this goal by assuming that the manager chooses actions leading to a least risky liquidation value. Consequently, after identifying actions that are optimal with respect to first-order effects in managerial decision making, we shall discriminate among multiple solutions. We shall identify *that one* which is optimal (for the manager) with respect to second-order effects (i.e., that which is least risky).

It suffices, for our first-order analysis, to examine managerial decision making

that is based upon:

$$\max_d E\{\tilde{L}_3 \mid N, d\}. \tag{4}$$

($E\{\cdot \mid N, d\}$ is the conditional expectations operator, when the manager knows the firm's news to be N (=G or B), and d is the manager's capital structure decision). Analysis of second-order effects will be based upon diminution of risk to the distribution of $\tilde{L}_3$, conditional upon information N and decision d.

B. Signalling through Capital Structure

Recall that prospects for the firm's investment are better when it has Good News than when it has Bad. Thus, the manager with Good News is motivated to convey that news to investors, in order to "separate" his or her firm's prospects. If the manager succeeds, the firm will receive better pricing for its securities, and the liquidation value to equityholders will be enhanced.

Our first two results state that the manager can accomplish this goal neither through the issuance of new equity nor through the issuance of two-period bonds:

LEMMA 1. *The manager of a firm with Good News cannot signal his or her firm's better prospects through the issuance of new equity.*

LEMMA 2. *The manager of a firm with Good News cannot signal his or her firm's better prospects through the issuance of long-term, non-callable bonds.*[9]

Formal proofs of these Lemmas appear in the Appendix.

In contrast, either short-term debt or long-term, callable bonds *can* succeed in signalling the firm's better prospects:

LEMMA 3. *The manager of a firm with Good News can signal his or her firm's better prospects through the issuance of short-term debt.*

Proof: Suppose that the manager of a firm with Good News issues short-term debt. When either type of news about the firm is revealed at time $t = 2$, the firm will be worth at least \$1.00. Short-term debt, offering exactly \$1.00 in payment at time $t = 2$, will therefore be priced at \$1.00. Sufficient capital to carry out the firm's project will be raised. Refinancing must take place at time $t = 2$. But the firm's information will be public at that time. So, the firm with Good prospects can avoid pooling its prospects with those of a Bad News firm.

Thus, a Bad News firm cannot succeed in obtaining better results by imitating the behavior of a firm whose news is Good. The equilibrium is *separating*. But we must still ask whether a firm with Bad News would, nevertheless, issue short-term debt and thereby prevent *signalling*. Our answer is a clear no. Because the short-term debt is riskless, all risk to the intermediate valuation (and therefore,

[9] Again, note that our example focuses upon *financial* rather than upon *production* decisions of the firm. Under more complicated models that incorporate production, issuance of long-term debt (in contrast to the issuance of new equity) could alter those production decisions. It would then be possible for the firm to incur *agency costs of debt*. (See, e.g., Galai and Masulis [7] and Jensen and Meckling [13]). This would add to the unattractiveness of long-ter. ı, non-callable debt that we later conclude in Corollary 5.

to the final liquidation value) of the firm is retained by equity. Because investors are risk-neutral, they do not find this objectionable. This indifference does not extend to the risk-averse manager, whose compensation is contingent upon the terminal value of equity. Consequently, a separating signalling equilibrium exists. Firms with Good News can issue short-term debt, and Bad News firms must respond by issuing some other security, one that is chosen for its optimal risk-sharing properties. Q.E.D.

An alternative to signalling through short-term debt is issuing callable bonds, with appropriate covenants:

LEMMA 4. *The manager of a firm can signal his or her firm's better prospects through the issuance of callable bonds.*

Proof: Suppose that the manager of a firm whose news is Good sets the following parameter values for the call price, K_G, and the promised payment, D_G, of the callable bonds:

$$K_G = \frac{10}{9} \quad \text{and} \quad D_G = \frac{20}{9}. \tag{5}$$

Under efficient pricing by a competitive capital market, this is a fair set of parameters to raise the \$1.00 in capital required for the firm's project.[10]

When to Call

Suppose that at time $t = 2$, the markets observe that the payoff to the firm will be \$10.00 with certainty. Were the firm to call, it would pay out \$10/9 to bondholders at time $t = 2$, which would be refinanced at the riskless rate (which we assume to be zero). Because the ability to pay this amount is now certain, refinancing will require a promised payment also equal to \$10/9. On the other hand, if the firm fails to call, bondholders will receive \$20/9 at time $t = 3$. Thus, managers will call in order to minimize payments to bondholders.

When Not to Call

Suppose, instead, that at time $t = 2$, the markets observe that the firm faces the lottery between \$10.00 and \$0.00. Not calling its bonds compels the firm to pay \$20/9 at time $t = 3$, contingent upon a realization of \$10.00. Calling at time $t = 2$ forces refinancing. Under the lottery faced by the firm, the firm will have

[10] If a signalling equilibrium exists, investors will associate the issuance of such a contract with the firm having Good News. Thus, they will price the callable bonds according to:

$$x = K_G \Pr\{\text{Call at } t=2 \mid G\} + E\{\min(V_3, D_G) \mid \text{Don't Call at } t=2, G\} \times \Pr\{\text{Don't Call at } t=2 \mid G\}$$

$$= \frac{10}{9} \times \frac{1}{2} + \frac{20}{9} \times \frac{2}{5} \times \frac{1}{2}$$

$$= 1.$$

Consequently, the offered contract raises precisely the \$1.00 in capital needed to carry out the firm's project.

to offer \$25/9 as a promised payment. But then, if the larger realization is attained, the firm would have to surrender an even larger value than if it had chosen not to call. The lesser realization provides \$0.00 in either case. Hence, the firm will choose not to call its bonds at time $t = 2$.

Separation and Signalling

The manager of a firm with Bad News will not follow suit. If, at time $t = 2$, it is publicly known that the firm will receive \$10.00 with certainty at time $t = 3$, our earlier analysis continues to hold. The firm will call their bonds, giving up \$10/9 at time $t = 3$.

If, instead, the Bad News firm faces the lottery at time $t = 2$, the firm will have to offer a refinancing contract that promises to pay \$20/9, if the \$10.00 payoff is realized. Consequently, the firm with Bad News will be indifferent between calling and not calling at time $t = 2$, under this realization.

The manager of a firm with Bad News will find that offering such a contract is suboptimal. To do so would imply surrendering an expected net present value of \$10/9 at time $t = 3$. If, instead, he or she were to issue new equity, the Bad News firm would be compelled to offer proportion $z_B = 3/20$ of its equity ownership in order to raise adequate capital to carry out its project. As a consequence, existing equityholders would limit the amount they will surrender at time $t = 3$ to an expected net present value of \$1.00. Thus, the contract described by (5) succeeds in establishing a separating signalling equilibrium. Q.E.D.

As the final step in examining our example, we now present a corollary to Lemmas 1 through 4. This corollary answers the question, "What will the firm with poorer prospects choose to issue?" Given the results of Lemma 3, we know that the answer will not be short-term debt. From among the remaining possibilities, we are able to conclude the following:

COROLLARY 5. *The manager of a firm with Bad News will issue equity.*

Proof: Suppose that long-term, non-callable bonds were issued. The market would price them according to:

$$x = E\{\min(\tilde{V}_3 + x - 1, D_B) \mid B\}, \tag{6}$$

which, for our example, would yield

$$x = D_B - \tfrac{1}{2}. \tag{7}$$

The residual value retained by existing equityholders would be:

$$\max(\tilde{V}_3 + (x - 1) - D_B, 0) = \frac{17}{2}, \tag{8a}$$

if the realization of project value were $\tilde{V}_3 = \$10.00$. Or it would be

$$\max(\tilde{V}_3 + (x - 1) - D_B, 0) = 0, \tag{8b}$$

if the realization were $\tilde{V}_3 = \$0.00$.

Now suppose instead that new equity were to be issued. It would be priced according to:

$$x = z_B\{(x - 1) + E\{\tilde{V}_3 \mid B\}\} \tag{9}$$

which would yield

$$x = \frac{\frac{17}{3} z_B}{1 - z_B}. \tag{10}$$

The value obtained by old equityholders would thus be

$$(1 - z_B)\{(x - 1) + \tilde{V}_3\} = 9 - \frac{10}{3} z_B, \tag{11a}$$

if the project's realized payoff were $\tilde{V}_3 = \$10.00$. And it would be

$$(1 - z_B)\{(x - 1) + \tilde{V}_3\} = \frac{20}{3} z_B - 1, \tag{11b}$$

if $\tilde{V}_3 = \$0.00$. It is now easy to show that any choice

$$1 > z_B > \frac{3}{20} \tag{12}$$

would both raise adequate capital for the project and compel the second-degree stochastic dominance of (11a) and (11b) over (8a) and (8b).

From what we have shown so far, any callable bond contract that could possibly compete with new equity must demand that call occur under some contingencies but not under others. (Otherwise, it constitutes either short-term or long-term debt, both of which we have already argued are dominated by equity.) This requires that:

$$K < D_B < K + 1. \tag{13}$$

Pricing then satisfies:

$$x = \frac{K}{3} + \frac{D_B}{3} + \frac{x - 1}{3},$$

i.e.,

$$x = \frac{K}{2} + \frac{D_B}{2} - \frac{1}{2}. \tag{14}$$

This yields three possible realizations for the existing equityholders. When, at time $t = 2$, it is certain that $\tilde{V}_3 = \$10.00$, equityholders receive:

$$\tilde{V}_3 + (x - 1) - K = \frac{17}{2} + \frac{D_B}{2} - \frac{K}{2}. \tag{15a}$$

If, instead, at time $t = 2$, the firm faces the lottery, equityholders will receive:

$$\tilde{V}_3 + (x - 1) - D_B = \frac{17}{2} + \frac{K}{2} - \frac{D_B}{2}, \tag{15b}$$

if the realization is $\tilde{V}_3 = \$10.00$. Or they will receive

$$0, \tag{15c}$$

if the realization is $\tilde{V}_3 = \$0.00$.

By choosing z_B large enough, one can make (11a) and (11b) arbitrarily close to the constant value 17/3. No choice of K and D_B can achieve the same goal under (15a), (15b), and (15c). Hence, issuance of equity is preferred by the firm's manager. Q.E.D.

II. Strict Superiority of Callable Bonds

To this point in our example, we have seen that both short-term debt and callable bonds can serve the purpose of signalling a firm's better prospects. This result bears striking similarity to the findings of both BT and BHS, in which firms were indifferent between these alternatives. In contrast, we now turn to the major point of this paper, to establish strict preference for callable bonds.

THEOREM 1. *The manager of a firm with Good News, in signalling the firm's better prospects through callable bonds, can achieve a reduction in the risk to his or her compensation—compared to what can be achieved through the issuance of short-term debt.*

Proof: Re-examination of the proofs of Lemmas 3 and 4 indicates that, after having issued its securities offerings, the Good News firm would face the following lotteries for the residual value to be retained by existing equityholders:

After Having Issued Short-Term Debt

$$\begin{aligned} 9 \quad &\text{with probability} \quad \frac{1}{2} \\ 7.5 \quad &\text{with probability} \quad \frac{1}{5} \\ 0 \quad &\text{with probability} \quad \frac{3}{10} \end{aligned}$$

After Having Issued Callable Bonds

$$\begin{aligned} \frac{80}{9} \quad &\text{with probability} \quad \frac{1}{2} \\ \frac{70}{9} \quad &\text{with probability} \quad \frac{1}{5} \\ 0 \quad &\text{with probability} \quad \frac{3}{10}. \end{aligned}$$

The latter distribution *second-degree stochastically dominates* the former. Therefore, it is preferred to the first by the risk-averse manager of a firm with Good News. Q.E.D.

III. Summary and Conclusions

Potent theories grow over time and provide ever more detailed description and explanation of the world. This vitality is quite apparent in capital structure signalling theory. Ross' [22] early approach contrasted "straight debt" with equity. Leland and Pyle [15] concentrated upon the case of an entrepreneurial firm first going public. Both pieces constitute significant contributions in stimulating the interest of financial economists in signalling explanations for corporate capital structure decisions. But clearly, both limited their descriptions to atypical cases.

More recent work in capital structure signalling theory has attempted to get closer to normative justification of major existing institutions. Harris and Raviv [8] developed a signalling explanation of call policy for callable convertible bonds. Their theory attempted to resolve the discrepancy between Ingersoll's [10] theoretical optimal call policy and the conflicting empirical evidence that he observed (Ingersoll [11]).

Our work continues in the spirit of Harris and Raviv. It attempts to use signalling theory to explain explicit details of one of the most noteworthy features of observed corporate finance: the inclusion of call provisions among the covenants of bonds. No motivation for this institutional fact has heretofore been fully established in the finance literature.

Under perfect and complete markets assumptions, managers should be indifferent between callable and non-callable debt. Consequently, recent attempts to provide explanations for the existence of call provisions have focused on market imperfections. In particular, BT [4] and BHS [2] suggested that these provisions help to alleviate incentive agency problems in the choice of investments. However, they demonstrated callable debt only to be equivalent to short-term debt in accomplishing this function.

In the current paper, we use informational asymmetry to provide a motivation for the existence of callable bonds. Risk-averse managers, with appropriately defined compensation contracts, face the task of signalling firm value to the securities markets. Employing an example similar to that used by BT [4], the signalling potential of equity, long-term (callable and non-callable) debt, and short-term debt were examined.

In this setting, we demonstrated that a firm can signal its better prospects through the issuance of either short-term debt or callable bonds. Neither equity nor non-callable debt prove effective signalling mechanisms because a firm with poorer prospects can succeed in pooling its prospects with those of a firm having better prospects. This pooling is possible because neither non-callable debt nor equity provide for financial recontracting once the firm's prospects are revealed. Furthermore, we have demonstrated that a firm with poorer prospects will choose to issue equity due to its superior risk-sharing capabilities. Taken together, these findings suggest a rationale for the absence of long-term, non-callable debt from observed corporate capital structure.

In contrast, both callable bonds and short-term debt can serve to establish a separating signalling equilibrium. We find, however, that callable bonds can satisfy a goal beyond the capabilities of short-term debt. At the same instant that they serve as a signal, callable bonds can also reduce managers' risk. The

hidden nuance of callable bonds is that the firm retains a *moderate* amount of its earnings in all states of the world. The firm's residual value (after payments are made to debtholders) is stabilized. It is lessened under outstanding realizations but heightened under poorer ones. Thus, from the manager's perspective, callability provides dominant risk-sharing qualities.

Appendix

Proof of Lemma 1

Proof: Suppose the contrary. Efficiency of competitive capital markets dictates that the amount, x, paid for the new equity issue when the firm has Good News would satisfy the following fixed-point pricing result:

$$x = z_G\{(x - 1) + E\{\tilde{V}_3 \mid G\}\}, \tag{A1a}$$

where z_G denotes the proportion of the firm that will be owned by new equityholders and $\tilde{V}_3$ denotes the random terminal value of the entire firm. Furthermore, since the offering proportion, z_G, must raise adequate capital to fund the firm's project, we demand the additional constraint

$$x \geq 1. \tag{A1b}$$

Equation (A1a) follows from the facts that \$1.00 from x will be invested in the firm's technology and the remaining $x - 1$ will be invested elsewhere in the economy. If the latter, it will have a payoff exactly equal to the amount that was invested. Hence, valuation of the entire firm is represented by the term inside the parentheses on the right-hand side of (A1a). The constant multiplier, z_G, then reflects the fact that new equity obtained only *that* specific proportionate share of the total firm value.

To solve (A1a) for the price x to be paid for the securities, we substitute for $E\{\tilde{V}_3 \mid G\}$ and rearrange:

$$x = \frac{6z_G}{1 - z_G}. \tag{A2}$$

Finally, we ask the question: Does the manager of a firm with Bad News have the incentive to falsely signal that his or her firm's information is G? The answer to this question is affirmative, since he or she would then be optimizing:

$$E\{\tilde{L}_3 \mid B, \text{ new equity offering proportion } z_G\}$$
$$= (1 - z_G)\{(x - 1) + E(\tilde{V}_3 \mid B)\}. \tag{A3}$$

Using (A2) and the fact that

$$E\{\tilde{V}_3 \mid B\} - 1 = \frac{17}{3},$$

(A3) then reduces to:

$$(1 - z_G)\left\{\frac{6z_G}{1 - z_G} + \frac{17}{3}\right\} = \frac{17}{3} + \frac{z_G}{3}. \tag{A4}$$

Under our supposition of a separating signalling equilibrium, the manager of a firm with Bad News should be able to generate only that expected value for his or her firm's old equityholders, irrespective of the capital structure he or she establishes. But this is in direct conflict with (A4) because (A1b) implies that $z_G > 0$. Thus, the manager of a firm with Bad News would imitate the behavior of the manager of a firm with Good News. As a consequence, no signalling equilibrium is possible through the issuance of new equity by a firm with Good News. Q.E.D.

Proof of Lemma 2

Proof: As in the proof of Lemma 1, suppose the contrary. Then, for such a separating signalling equilibrium to exist, there must be a promised payment on the debt, D_G, that can be offered by the manager of a firm with Good News and which the manager of a Bad News firm will not choose to imitate. Efficient pricing by the capital markets would dictate a fixed-point result:

$$x = (x - 1)\ \Pr\{\tilde{V}_3 = 0 \mid G\} + E\{\min(\tilde{V}_3 + x - 1,\ D_G) \mid \tilde{V}_3 = 10\}\ \Pr\{\tilde{V}_3 = 10 \mid G\}, \quad \text{(A5a)}$$

subject to the side constraint (A1b) that sufficient capital be raised to carry out the firm's investment project. In our example, (A5a) immediately simplifies to:

$$x = \{(x - 1)(0.3)\} + \{\min(x + 9,\ D_G)(0.7)\}.$$

It is easy to show that $x + 9 \geqq D_G$. Hence, we are able to reduce (A5a) to a simpler fixed-point result:

$$x = \{(x - 1)(0.3)\} + \{D_G(0.7)\} \quad \text{(A5b)}$$

for which rearrangement yields:

$$x = D_G - \frac{3}{7}. \quad \text{(A6)}$$

In order that a separating signalling equilibrium exist, the manager of a Bad News firm must have no incentive to falsely signal that his or her firm's information is Good. To see that the manager does not, recognize that a Bad News firm's residual expected liquidation value, after making payments to debtholders, would be:

$$E\{\tilde{L}_3 \mid B, \text{ debt offering payment } D_G\} = E\{\max(\tilde{V}_3 + x - 1 - D_G,\ 0) \mid B\}. \quad \text{(A7)}$$

Using (A6), (A7) reduces to:

$$= E\left\{\max\left(\tilde{V}_3 - \frac{10}{7},\ 0\right) \middle| B\right\}$$

$$= \frac{40}{7},$$

exceeding the 17/3 that should be due the firm with Bad News, under the supposition of a separating signalling equilibrium. We conclude that the signalling equilibrium fails for lack of incentive-compatibility on the part of managers of Bad News firms. Q.E.D.

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