Bond calls, credible commitment, and equity dilution: A theoretical and clinical analysis of Simultaneous Tender and Call (STAC) offers

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Summary. This paper is an exploration of the ability of game theory to explain real-world corporate maneuvering. We explore this issue by investigating bond tender offers accompanied by a threat to call nontendered bonds, so called "Simultaneous Tender and Call"(STAC) offers. We argue that STACs engender a rather transparent game played by bondholders and shareholders. We model this game and, using this model, we predict the outcome of STACs. Finally, we investigate the issue of whether this theoretical model is of value in explaining the outcomes of four actual STAC issues made by James River, May Department Stores, and Houston Lighting & Power Company. Our clinical analysis provides support for explanatory power of our model. Calibrating the predictions of the model with data from these STACs, we demonstrate a correspondence between theory and actual corporate behavior. As predicted by our model, subgame perfection (i.e., threat credibility) and preplay coordination are central to explaining the outcomes of the STACs.

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1 Introduction

Are analytic game-theoretic models of financial strategy useful for interpreting actual cases of strategic maneuvers in the corporate world?[1]

This is a question of some interest both to practioners and to researchers. For practioners, the question is important because its answer will determine the extent to which formal strategic modeling can be utilized by managers in formulating key strategic decisions. For researchers the question is interesting because, if strategic models fit clinical situations fairly well, then clinical situations will suggest insights that can be used in the construction of new theoretical hypotheses and perhaps the design of experimental studies. In this paper we plan to address the question of whether game theory can be applied fruitfully to explain concrete instances of financial maneuvering by actually applying game theory to three firms that used Simultaneous Tender and Call (STAC) offers in 1992.

STACs are tender offers for nonrefundable debt issues accompanied by a threat to call all nontendered bonds. Nonrefundable debt is debt issued with a nonrefundability covenant. Such debt can be redeemed in total at a fixed call price that may be substantially below market value. However, redemption using funds from new lower interest rate securities is prohibited.[2] Thus, the issuer can call the debt but only if the issuer has enough "clean cash" to execute the call. Clean cash is cash that is not generated by debt issues at interest rates lower than the rates on the bonds protected by the nonrefundability covenant. When market rates have fallen substantially, these provisions effectively preclude the issuance of new debt to call old debt issues. At the same time, the nonrefundability provisions allow the issue to be called with "earmarked" cash from asset sales, operating earnings, and/or new issues of common stock. Preferred stock issues, with tax-adjusted dividend rates lower than the prohibited rate on the bonds, that subsititue for debt issuance may also be prohibited. (See Fisher and Greenfield (1984).

[1] This question cannot be assessed simply through standard econometric tests of the predictions of such models. Such tests answer a different question. They determine if strategic models govern the economic phenomenon in question. They do not address the issue of whether these models provide useful insights to agents in the field. No one doubts that the laws of physics govern soccer matches. However, this does not provide evidence of whether physicists make good match commentators.

[2] Closely related to nonrefundable debt contracts are contracts with "clawback provisions"; these provisions permit only a fraction of the nonrefundable debt to be redeemed, even if the redemption is accomplished without refunding. (See Goya, Gollapudi, and Ogden (1997)).

A STAC is a tender offer for an outstanding issue of nonrefundable debt. The tender price is set (usually slightly) above the call price, and the firm states, in the Offer to Purchase, that all nontendered bonds will be called soon after the tender offer, hence the name, Simultaneous Tender and Call offer.

Thus, the Offer to Purchase specifies a fairly simple game between bondholders and shareholders. Shareholders set the tender-offer price, bondholders decide whether to tender into the offer, if some bonds are not tendered, shareholders then decide whether to “pull the trigger” and redeem all the remaining bonds, issuing equity if redemption requires raising clean cash. Note that, relative to most financial situations featuring strategic maneuvers, the structure of the game in a STAC offer is straightforward (for a contrasting situation simply consider a hostile takeover with multiple bidders): the players are well defined, the order of moves is determined by the Offer to Purchase, and the payoff to the parties are limited to the economic value effects of the STAC on debt and equity value. Firm-specific human capital, non-pecuniary control rents, and managerial effort costs do not appear to play a major role. Thus, the strategic situation produced by a STAC is one that is relatively transparent to model. If theory cannot provide insight in these sort of transparent situations, is not likely to be able to do so in much richer environments featured in most other strategic situations in finance.

Our theoretical analysis formalizes this transparent structure in as simple a fashion as possible. In our model, debt is held by a group of bondholders, each of which owns a fraction of the total issue. The firm has enough clean cash from past equity issues and operating earnings to call a fraction of the outstanding debt. However, it may not have enough clean cash to call the entire issue. Raising new clean cash via the issuance of nondebt securities is costly because of taxes, dilution losses from adverse selection, or corporate control reasons. Thus, shareholders have the option of attempting a STAC offer. Calling nontendered bonds by shareholders is not beneficial to bondholders. If it is also not in the interest of the stockholders to call the debt, neither party has any incentive to enforce the redemption mandated by the STAC offer. For this reason, the threat of subsequently redeeming the bonds, incorporated in the STAC offer, is just that, a threat, not a binding commitment.

In our theoretical analysis, we assume that threats only have force if it is in the ex post interest of the agent making the threat to carry it out. In other words, we restrict attention to subgame perfect equilibria in which shareholders follow sequentially rational tendering and calling strategies. If shareholders could commit to calling non tendered bonds, even when calling is not in their ex post interest, then rational bondholders would always tender into the STAC offer. Absent the ability to precommit, a key parametric condition affecting the outcome of the STAC is whether shareholders prefer bearing the costs of redemption with clean cash to leaving the issue outstanding even when *all* bondholders refuse to tender. We call this condition the *credible commitment condition*. If the credible commitment condition is satisfied, the STAC succeeds in every subgame perfect equilibrium. Note that when the credible commitment condition is satisfied, shareholders' payoffs from the STAC can still exceed their payoffs from simple redemption. The willingness of the shareholders to pull the trigger on the redemption threat will cause rational bondholders to cave in and tender their bonds into the STAC. However, because the bonds are tendered, there is no need for the shareholders to incur the costs associated with clean-cash redemption threat. Satisfaction of the credible commitment condition depends on the cost/benefit calculation associated with redemption. This calculation, in turn, depends on the call price, the intrinsic value of the outstanding bonds, and the cost of equity dilution. The intrinsic value of the bonds depends on the credit risk associated with the bonds and the coupon rate. Credit risk lowers the market value of bonds and this lowers the incentive to call. A higher coupon rate increases the value of the bonds and thus increases the incentive to call.

If the credible commitment condition is not satisfied, the optimal redemption decision for the shareholders depends on the tendering decision of bondholders. If only a few bondholders refuse to tender, little clean cash will be needed to redeem bonds of the holdouts. Thus, ex post, redemption will be optimal for shareholders. In contrast, when most bondholders resist the STAC, a large amount of clean cash must be raised to redeem the outstanding bonds. The costs associated with raising clean cash may make the calling suboptimal. In short, resistance by bondholders is self reinforcing. Thus, when the credible commitment condition is not satisfied, multiple equilibria may emerge—some featuring bondholder resistance, and some featuring STAC success. However, in all coalition-proof Nash equilibria, the STAC will fail. Coalition proofness is an appropriate solution concept for noncooperative games (in extensive or normal form) when communication between the parties is unlimited and costless.[3] Thus, our analysis predicts that, when the credible commitment conditon is not satisfied, and bondholders coordinate their actions, STACs will fail. In contrast, if coordination is imperfect, STACs may succeed even when the credible commitment condition is not satisfied.

With these theoretical results in hand, we turn to assessing the power of the theory for explicating the actual play of events in well-documented STACs by James River, May Department Stores, and Houston Lighting & Power. To match theory with the cases, we evaluate the satisfaction of the credible commitment condition and the prospects for bondholder coordination. These evaluations combined with our theory yield predictions regarding the outcome of the four cases we consider. To evaluate the ability of theory to explicate these events, we compare these predictions with the actual outcomes of the four STACs.

This analysis reveals that the credible commitment condition is satisfied in only one of the four STACs—Houston Light & Power Company. In this case, as predicted by theory, bondholders tendered into the

[3] Coalition proofness is a *noncooperative* solution concept because it considers only payoff vectors that are self enforcing. Cooperative game theory considers all payoff vectors a coalition can engender. See, for example, Bernheim, Peleg and Whinston (1987), Moreno and Wooders (1996), and Ferreira (1999) for a discussion of these points.

STAC without resistance. In the other two cases—James River and May Department Stores—the credible commitment condition was not satisfied. Bond ownership in the case of May Department Stores was very concentrated and the "stakes" in the May case were very high; i.e., the intrinsic value of the issue was high relative to the call price. Thus, May's potential gains from a successful STAC (and the corresponding potential losses to bondholders) were large. At the same time the dilution costs associated with financing the call were even higher. Thus, the gains from redemption were large but bond ownership was concentrated and the call threat was not credible. In this case, our theory predicts coordinated bondholder resistance. This is exactly what we observe in the case of May. In the case of James River, in contrast to the May Department Stores, the potential gains to stockholders (and thus losses to bondholders) from redeeming the bonds were smaller. At the same time, bond ownership was much more diffuse. Thus, both the incentives for preplay bondholder coordination and the potential gains from coordination were smaller. Consistent with theory, coordinated resistance did not emerge in this case despite the failure of the credible commitment condition.

Overall the results of the four STACs are consistent with the predictions of our theory. Subgame perfection of threats was important to bondholders when evaluating shareholder call threats. This is apparent both from the outcomes of the STACs and from the narrative descriptions of bondholder–stockholder communication in the STAC cases. When coalition formation was both cheap (because of ownership concentration) and valuable (because of the bond yields), coalition proofness also played an important role. Thus, in the case of STACs, game theoretic modeling was able to provide significant insight into the evaluation of four real world cases. This provides qualified support for the utility of formal strategic analysis at the clinical level.

This paper is organized as follows. In Section 2, a brief description of the institutional background for STAC issues is presented. In Section 3, a simple model of STAC offers is developed. In Section 4, a narrative description of the cases is provided. In Section 5, the theory is applied to the data. Section 6 concludes the paper.

2 Institutional Background

2.1 Issuance of nonrefundable debt

In the late 1970s and early 1980s, a large number of firms issued nonrefundable debt. The conventional wisdom regarding the motivation for nonrefundable issues in this high-interest-rate period was that investors were concerned about firms recalling their debt when interest rates fell to more "normal" levels. Firms, to reduce required yields, were willing to provide call protection by attaching nonrefundability guarantees to their bonds. Typically, these guarantees prohibit the firm from calling its debt with the proceeds of a lower-interest-rate debt issue for a period of ten years after the bond is issued. The popularity of these guarantees in the late 1970s is documented by Thatcher (1985) who found that 79 out of 118 bonds, issued during the period January 1 to June 30, 1975, had nonrefundability guarantees. The cumulative effect of these issues on the bond market of the 1990s was documented by Crabbe (1992) who estimated that, in 1992, about $50 billion in nonrefundable debt was outstanding.

2.2 Non-refundability covenants

The exact scope of the nonrefundability restriction is a matter of considerable dispute. However, important legal precedents regarding refundability were established in *Morgan Stanley & Co. vs. Archer Daniels Midland Co.*, 570 F. Supp. 1529, 1542 (S. D. N. Y. 1983). In this case, Morgan Stanley challenged Archer Daniels Midland's redemption of a nonrefundable debt issue.

The facts of the case are as follows: Archer Daniels Midland (ADM) issued equity earmarked for redeeming a nonrefundable debt issue. In response to the redemption, Morgan Stanley sued ADM, arguing that because of the fungibility of funds, ADM's substantial borrowing program (at interest rates lower than the rate on the nonrefundable debt) before the redemption "at least indirectly" facilitated financing the redemption; thus, the redemption violated the nonrefundability covenant. ADM countered by arguing that the redemption was not a violation because it passed the "sole source test"; i.e., as long as the source for the cash used for the refunding is clearly earmarked and "clean," redemption cannot violate the nonrefundability covenant regardless of how much low-cost borrowing the firm has engaged in before redemption. The court sided with ADM and the sole-source test.[4]

The ADM decision seems to indicate that, as long as the firm has earmarked clean cash to redeem the bonds, the nonrefundability covenant is not violated by redemption. However, in a footnote to the ADM decision, the court expressed a caveat—if ADM had immediately issued new low-cost debt to repurchase the equity earmarked for redeeming the high-cost nonrefundable debt, then the nonrefundability provisions would "arguably" have been violated because the firm would have been "virtually in the same financial posture after the transaction as it was before the redemption—except that the debt would have carried lower interest rates." This footnote seems to point to the importance of looking at the firm's financing policy when determining if nonrefundability restrictions have been violated. Legal scholars, such as Fisher and Greenfield (1984), argue that the courts should extend the logic of the footnote in *Morgan Stanley & Co. vs. Archer Daniels Midland Co.* to preclude refunding unless (a) the firm has not issued any lower interest debt in the period surrounding the refunding or (b) the firm's indebtedness in the period surrounding the refunding falls by an amount at least equal to the magnitude of the refunding.

2.3 The Simultaneous Tender and Call

When interest rates began to fall in the late 1980s, the call options embedded in nonrefundable bonds became very valuable. For reasons we explore later, a number of firms desired to call their outstanding

[4] Support for the sole-source test was also provided by the decision in *Franklin Life Insurance Co. v. Commonwealth Edison Co.* (451 F. Supp. 602 (S.D. Ill. 1978).

high-yield debt without issuing equity. STACs were designed by investment bankers at Morgan Stanley, Merrill Lynch, and Goldman Sachs to accomplish this objective. All STAC offers have a number of common characteristics:

- fixed dates for both the front-end tender and the back-end redemption call are announced simultaneously and presented to bondholders in the same document (the Offer to Purchase);
- the money used in the front-end tender offer is not restricted to being "clean" cash;
- the period between the tender offer and the call is normally very short, e.g., 2 to 3 weeks; and
- the Offer to Purchase claims that the call subsequent to the tender is unconditional, irrevocable, and and for all outstanding bonds not tendered into the front-end tender offer.

In the next section, we develop a model that captures, in a stylized fashion, the salient features described above.

3 A model of STAC offers

3.1 Framework

3.1.1 Outline

Consider a three-date, two-period world. All agents are risk neutral and the risk-free rate of interest is 0. At date 0, the firm has a zero-coupon nonrefundable debt issue outstanding. This debt issue will mature at date 2. At date 0, the shareholders have the option of selecting the tender price of a STAC offer for the firm's debt. At date 1, the shareholders have the option of calling all (or not calling any) of the bonds outstanding after the STAC offer. The call of the remaining bonds must be funded entirely with clean cash, originating either from existing balances or from an equity issue. The timing of the key events is illustrated below below.

date 0	date 1	date 2
Shareholders attempt to repurchase debt via a tender offer.	If any debt remains outstanding, it can be called by the firm with clean cash.	cash flows are realized and divided between claimholders.

3.1.2 Assets

The firm has two assets: a cash balance available at date 0, and a random cash flow of $\tilde{X}$ dollars, received at date 2. The cash balance consists of a mixture of clean cash, L_0, and dirty cash, D_0. This cash can be used to retire debt. Cash not used to retire debt at either date 0 or date 1 is paid out to shareholders as a dividend.[5] The random date 2 cash flow $\tilde{X}$ is non-negative. Moreover, this cash flow has an absolutely continuous distribution function G and a density function g.

3.1.3 Liabilities

At time 0, the firm has a single zero-coupon bond issue outstanding. This issue consists of n bonds. Each bond is held by a different bondholder. Therefore there are n bondholders. All bonds have a face value of f. Bonds can be called at date 1. The call price of the bonds is χ. The bonds are nonrefundable. Any call of the bond issue must completely call all the bonds remaining after the tender offer with "clean cash." We assume that

$$\chi < L_0 < n\,\chi. \tag{CC}$$

This *clean cash assumption*, (CC), implies that the shareholders have sufficient cash to call the bond of a single bondholder with clean cash, but the shareholders do not have sufficient cash to call the entire bond issue with clean cash. With regard to dirty cash, D_0, we make the following assumption:

$$D_0 \geq n\,f. \tag{DC}$$

This *dirty cash assumption*, (DC), implies that the shareholders have enough dirty cash to buy up the entire issue through a tender offer even if the tender offer is priced at the highest possible tender price, f, the face value of the bonds. Because calling the bond at a price higher than the bonds face value is not rational for zero-coupon bonds, and because we want to model bond calls, we assume that the call price, χ, is less than the face value of the bonds, f.[6]

3.1.4 Issue costs

We assume it is costly to raise the clean cash (to call the issue) by issuing securities not subject to nonrefundability constraints. For simplicity, we assume, consistent with many refundability covenants, that

[5] As will become apparent later, this residual payout policy maximizes the value of the firm's equity. Thus, the residual policy we assume will be adopted whenever it is permitted. The residual payout assumption is equivalent to assuming that there are no covenants restricting dividend payments. Adding dividend covenants to the model neither produces new insights nor modifies the results of our analysis in a qualitative fashion.

[6] This counterfactual assumption entails no loss of generality and follows from the fact that the bonds in our model have no coupon. The lack of a coupon implies that the market value of the bonds can never exceed their face value. The call option is only valuable for the firm if the call price is less than the market price. Therefore, for the call option to have value, the call price must be below the face value of the bonds. In reality, most callable bonds are coupon paying and most call prices exceed par value. We could allow for call prices above the bond's face value either by assuming an intermediate date interest payment or by calling part of the terminal payment an interest payment. The extension of the analysis in this direction is trivial and produces no new insights.

refinancing with preferred stock is effectively prohibited. Thus, the cash for refunding the firm's debt must be raised by issuing equity. There are many potential costs associated with issuing outside equity. For simplicity, we simply take a "reduced-form" approach and capture these costs by assuming that each new dollar of outside equity financing generates a cost of $\iota \in [0, 1]$ dollars. In reality, new issuance costs could arise in a number of ways, e.g., the adverse selection costs associated with the issuance of nondebt securities. Another possible cost of equity issuance is the loss of debt tax shields.

The analysis in this paper assumes that the amount of clean cash is common knowledge. In the three clinical studies it appeared that there was some uncertainty regarding the exact amount of clean cash. On the one hand, introducing symmetric but uncertain information regarding the size of the clean cash balance would produce no new results or insights. Bondholders would simply use their expectations regarding the amount of clean cash to make their decision regarding whether to tender into the STAC.

On the other hand, if we assume that stockholders have private information relating to the fraction of corporate cash that is clean and that launching a STAC is costly, then a model of STAC issuance could be constructed in which launching a STAC signaled the presence a large clean cash balance. ns at the time of announcement. There are two reasons why we do not analyze STACs from this private information perspective. First, incorporating private information would greatly complicate the analysis. Second, we are not convinced that firms, in fact, had private information regarding the size of their clean cash balance. Clearly there was uncertainty regarding the amount of clean cash based on uncertainty regarding how courts would measure clean cash. However, all possible court definitions appeared to be based on public accounting information. In this situation, shareholders were not informationally advantaged relative to bondholders.

3.1.5 Strategies

The first stage of the STAC offer occurs at date 0. At this date, shareholders announce a tender offer for the firm's debt and issue a threat to call nontendered bonds. In conformance with extant practice and legal guidelines, the repurchase is irrevocable and unconditional. Because the tendering of bonds for a price less than χ is a dominated strategy for bondholders and because offering a price of more than f for the debt is a dominated strategy for the shareholders, we assume that the tender price t offered by the shareholders lies between χ and f. Thus *the shareholders' date 0 strategy is a tender price*, $t \in [\chi, f]$.

After the terms of the STAC are set by shareholders, the first or "front-end" stage of the STAC occurs. Each bondholder decides whether to "accept" the tender offer by tendering her bond or "reject" the offer by not tendering her bond. Let n_τ represent the aggregate number of bonds tendered by bondholders into the offer. There are $i = 1, 2, \ldots n$ bondholders. *Thus, a strategy at time 0 for bondholder i consists of a probability of tendering conditioned on the tender price, t, offered by the shareholders.*

The second or "back-end" stage of the STAC occurs at date 1. At this time, shareholders decide whether to carry out their threat to call all nontendered bonds. If they decide to call, they may have to raise additional clean cash to comply with nonrefundability conditions. Thus, *the time 1 strategy of shareholders is a binary call/no call decision conditioned on all the actions taken before date 1.*

At date 2, firm cash flows are realized and divided between stockholders and any remaining bondholders. No decisions are made by the agents at date 2.

3.1.6 Bond valuation at date 1, no call

Maximizing shareholder payoffs is equivalent to minimizing the sum of the expected payoffs to bondholders and the issue costs associated with new equity. Thus, the shareholders' payoff depend only on the value of nontendered bonds and and the issue costs. Bondholder payoffs depend on the value of nontendered debt and the tender price of the STAC. The value of nontendered bonds depends on the number of bonds outstanding, cash flows available to service those bonds, and the likelihood of a call at date 1. Because n bonds are outstanding at date 0, if n_τ bonds are tendered, then $n - n_\tau$ bonds will remain outstanding after the tender offer. The total face value of debt in this case equals $(n - n_\tau)\, f$. Thus, the total value of outstanding debt, V_d, at date 1 assuming that the shareholders do not call the issue, is given as follows:

$$V_d(n_\tau) := \mathrm{E}\{\min[\tilde{X}, (n - n_\tau)\, f]\} = \int_0^{(n-n_\tau)\, f} (1 - G(x))\, dx.$$

The *intrinsic value* of an individual bond, v, is given as follows:

$$v(n_\tau) = \frac{V_d(n_\tau)}{n - n_\tau}; \quad n - n_\tau > 0.$$

The intrinsic value of the bond is the price the market would assign to the bond if the market believed that the bond would never be called. By continuity, we extend the definition of v to allow for $n_\tau = n$. That is, we define,

$$v(n) = \lim_{n_\tau \to n} \frac{V_d(n_\tau)}{n - n_\tau} = f.$$

This extension is only used for convenience. The extension allows us to avoid, in statements of results, separate treatment of the case where all bonds are tendered.

3.2 Analysis

3.2.1 The date 1 decision

Let L_1 (D_1) represent the balance of clean (dirty) cash at date 1. This balance consists of the initial cash balance less the payments made to bondholders for tendered bonds. Because the firm can always repurchase the bonds at time 0 with dirty cash, the clean cash balance at time 1 remains L_0. Thus, at date 1, the firm's cash balance consists of $D_1 = D_0 - n_\tau\, t$ in dirty cash and $L_1 = L_0$ in clean cash. All of the clean cash can be applied to calling the debt.

At date 1, the shareholders have two options: call all the outstanding bonds at the call price or not call any outstanding bonds. If the amount required to fund the call, $(n - n_\tau)\, \chi$ is less than or equal to clean cash balance L_1, then, no new equity needs to be issued to fund the call. In this case, issuance costs are 0. In contrast, if $(n - n_\tau)\,\chi > L_1$, then $(n - n_\tau)\,\chi - L_1$ dollars of new equity must be issued to fund the call. As shown above, the clean cash balance at date 1 equals the clean cash balance at date 0. Thus, issuance costs are given by

$$\iota\ \max[(n - n_\tau)\,\chi - L_0, 0].$$

In order to call the issue, shareholders must pay bondholders $\chi\,(n - n_\tau)$. Thus, the total costs of calling the issue are given by

$$C(n_\tau) = \chi\,(n - n_\tau) + \iota\ \max[(n - n_\tau)\,\chi - L_0, 0].$$

The average repurchase price, is given by

$$c(n_\tau) = \frac{C(n_\tau)}{n - n_\tau}; \quad n - n_\tau > 0.$$

As we did with the bond value function, v, we extend the definition of the average issue-cost function by continuity to $n_\tau = n$, as follows: $c(n) = \chi$. The gain from calling the debt issue is the elimination of the debt obligation V_d. Thus, the optimal call policy is to call the remaining bonds only when the call price is no greater than total bond value $C(n_\tau) \le V_d(n_\tau)$, or equivalently in per bond terms, whenever $c(n_\tau) \le v(n_\tau)$.

First consider the price of debt. Note that v is continuous and that $v \le f$, the face value of the firm's debt. Next note that the derivative of the debt call function is given as follows:

$$v'(n_\tau) = \left(\frac{1}{n - n_\tau}\right)^2 \int_0^{f\,(n-n_\tau)} (G(f\,(n - n_\tau)) - G(x))\,dx.$$

Because the distribution function, G is nondecreasing, $G(f\,(n - n_\tau)) - G(x) \ge 0$, for all x in the range of integration, $[0, (n - n_\tau)\,f]$. Thus, $v' \ge 0$. Moreover, v' is strictly greater than 0 whenever $G(f\,(n - n_\tau)) - G(0) > 0$. Non-negativity and continuity of the distribution function imply that $G(0) = 0$. Thus, $v' > 0$ whenever $G(f\,(n - n_\tau)) > 0$, which is equivalent to $v' > 0$ whenever the the probability of default is positive. In summary, the intrinsic debt value is weakly increasing in the number of bonds tendered and is strictly increasing when debt is risky.

Next consider the average cost of repurchasing debt. Note that $c(n_\tau) \ge \chi$ and is continuous. Differentiating this expression with respect to n_τ yields

$$c'(n_\tau) = \begin{cases} 0 & \text{if } n_\tau > n - L_0/\chi \\ -\iota\, L_0 \left(\frac{1}{n-n_\tau}\right)^2 & \text{if } n_\tau < n - L_0/\chi. \end{cases}$$

The average cost of repurchasing debt is decreasing and strictly decreasing when some outside financing must be used to fund the call. This follows because, as more and more bonds are tendered, the fraction of the call that must be funded with costly outside equity falls, lowering the unit cost of the call. The fact that average call costs are continuous and decreasing (in the number of bonds tendered) and the price of the bond is continuous and increasing implies that either $c(n_\tau) > v(n_\tau)$, for all n_τ, or there exits a unique n^*_τ in the interval $[0, n]$ such that

$$v(n_\tau) \geq c(n_\tau) \text{ if and only if } n \geq n^*_\tau.$$

Let $\lceil n^*_\tau \rceil$ be the smallest integer greater than or equal to n^*_τ, that is, $\lceil n^*_\tau \rceil$ is obtained by rounding the fractional part n^*_τ up to the next integer. Finally, define $\bar{n}_\tau$ as follows:

$$\begin{aligned} &\text{If } c(n_\tau) > v(n_\tau) \text{ for all } n \in [0, n], \text{ let } \bar{n}_\tau = n; \\ &\text{if } c(n_\tau) \leq v(n_\tau) \text{ for some } n \in [0, n], \text{ let } \bar{n}_\tau = \lceil n^*_\tau \rceil. \end{aligned} \tag{NTau}$$

By the definition of n^*_τ, the following policy is optimal:

$$\begin{aligned} &\text{If } n_\tau < \bar{n}_\tau, \text{ call the remaining bonds} \\ &\text{If } n_\tau \geq \bar{n}_\tau, \text{ do not call the remaining bonds} \end{aligned} . \tag{CALLPOL}$$

Henceforth we assume that the shareholders follow the call policy given by (CALLPOL). The solution to the optimal call policy problem is illustrated in Figure 1.[7]

3.2.2 Response by bondholders to the date-0 STAC offer

Let $\tilde{N}_\tau$ denote the (possibly random) number of bonds tendered into the STAC at date 0. Let $\tilde{N}^i_\tau$ denote the number of bonds tendered by bondholder i; $\tilde{N}^i_\tau$ is a random variable that takes on the value of 0 if bondholder does not tender and 1 if bondholder tenders. Let $\tilde{N}^{-i}_\tau$ represent the number of bonds tendered by all bondholders other than bondholder i. Expression (CALLPOL) shows that if $\tilde{N}^{-i}_\tau \geq \bar{n}_\tau$, then the shareholders will call the bond issue at date 1; if $\tilde{N}^{-i}_\tau < \bar{n}_\tau$, shareholders will not call at date 1. On the one hand, when shareholders do not call the bond issue, a holdout bondholder will own a bond worth $v(\tilde{N}^{-i}_\tau)$. On the other hand, if $\tilde{N}^{-i}_\tau \geq \bar{n}_\tau$, shareholders call the issue and a holdout bondholder receives χ. Therefore, the payoff to a bondholder i, if she rejects the STAC offer and holds out is given by

$$\chi \, \mathrm{P}\{\tilde{N}^{-i}_\tau \geq \bar{n}_\tau\} + \mathrm{E}[v(\tilde{N}^{-i}_\tau) | \tilde{N}^{-i}_\tau < \bar{n}_\tau] \, \mathrm{P}\{\tilde{N}^{-i}_\tau < \bar{n}_\tau\}.$$

The payoff from tendering is t. Thus, tendering is a best response for bondholder i if and only if

$$\chi \, \mathrm{P}\{\tilde{N}^{-i}_\tau \geq \bar{n}_\tau\} + \mathrm{E}[v(\tilde{N}^{-i}_\tau) | \tilde{N}^{-i}_\tau < \bar{n}_\tau] \, \mathrm{P}\{\tilde{N}^{-i}_\tau < \bar{n}_\tau\} \leq t. \tag{T-i.}$$

Similarly, not tendering is a best response if and only if

$$\chi \, \mathrm{P}\{\tilde{N}^{-i}_\tau \geq \bar{n}_\tau\} + \mathrm{E}[v(\tilde{N}^{-i}_\tau) | \tilde{N}^{-i}_\tau < \bar{n}_\tau] \, \mathrm{P}\{\tilde{N}^{-i}_\tau < \bar{n}_\tau\} \geq t. \tag{NT-i.}$$

[7] Is the policy specified in (CALLPOL) the only optimal policy? Another optimal policy exists only if graphs of the c and v functions happen to meet at an integer. This is very unlikely given that there are only a finite number of integers among the (uncountably) infinite number of points at which the meeting could occur. In technical terms, the policy specified in (CALLPOL) is generically the unique optimal policy for the shareholders.

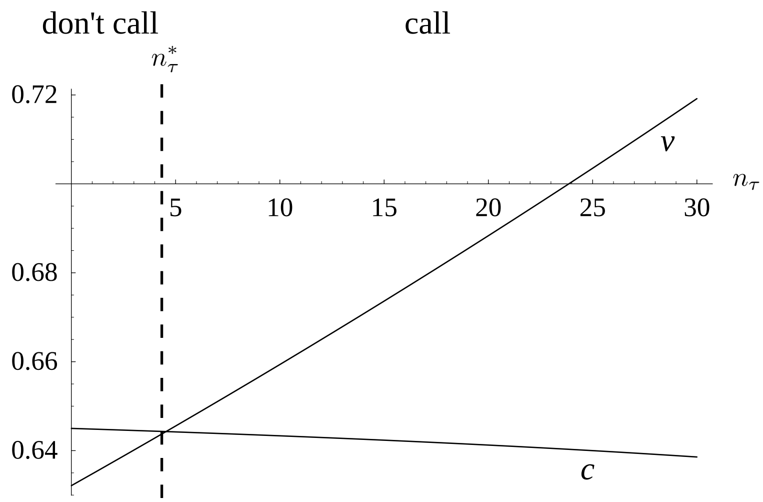

Figure 1. Date 1 call decision
The horizontal axis represents the number of tendered bonds, n_τ. Shareholders will call the the remaining bonds at date 1 whenever bond value, v, exceeds the average repurchase cost, c. The point at which shareholders are indifferent to calling is $n_\tau^* \approx 4.54076$. Therefore $\bar{n}_\tau = 5$, and the call policy specified by (CALLPOL) is as follows: do not call the remaining bonds if the number of tendered bonds, $n_\tau = 0, 1, \ldots 4$; call the remaining bonds if $n_\tau = 5, 6, \ldots 100$. The parameters for this example are as follows: $\chi = 0.60$, $f = 1.00$, $n = 100$, $\iota = 0.10$, $L_0 = 15.00$, $D_0 = 100.00$, cash flows, $\tilde{X}$, are exponentially distributed with mean 100.00.

For a given tender price t, bondholder tendering strategies $(\tilde{N}_\tau^1, \ldots \tilde{N}_\tau^n)$ satisfy the Nash equilibrium conditions for tendering strategies if and only if, for all bondholders, $i = 1, 2, \ldots n$,

1. whenever bondholder i tenders her bond with positive probability (i.e., $\mathrm{P}\{\tilde{N}_\tau^i = 1\} > 0$), (T-i) holds and
2. whenever bondholder i does not tender her bond with positive probability (i.e., $\mathrm{P}\{\tilde{N}_\tau^i = 0\} > 0$), (NT-i) holds.

In order for tendering to increase the shareholders' welfare, the tender price must be less than the debt's intrinsic value, $v(0)$. For this reason, we will henceforth restrict attention to STACs featuring tender offers less than the intrinsic value of the bonds, i.e., we assume that $t < v(0)$. The second necessary condition for an effective STAC is that some bonds are tendered. If no bonds are tendered, the STAC offer does not produce a higher payoff to the shareholders than a simple call with clean cash. Whether a bondholder tenders into the STAC offer depends on what they anticipate will happen if they don't tender. The outcome of not tendering, in turn, depends on the willingness of shareholders to carry out the threat to call the bonds. Along this dimension there are three cases to consider: (a) shareholders who are never willing to carry the call threat embedded in the the STAC, (b) shareholders who are sometimes willing to carry out the threat, and (c) shareholders who are always willing to carry out the threat.

In case (a), clearly the STAC will not be an effective tool for increasing shareholders' welfare. The reason is simple. Bondholders will forecast that the second stage call threat is empty. In this case, they will refuse to tender during the first stage unless the call price at least equals the intrinsic value of their bonds. Next, note that because the price of the bonds is increasing with the number of bonds tendered, and the cost of calling is falling, if the shareholders are ever willing to call the remaining bonds, they will be willing to call when there is only 1 bond not tendered into the STAC offer. Because, by assumption, the firm has enough clean cash to call the bonds of a single holdout, the cost of calling the lone holdout is just the call price, χ. Thus, for the threat to call a single holdout bondholder to be plausible, it must be the case that the following condition is satisfied:

$$\chi \leq v(n-1). \qquad \text{(PLAUS)}$$

We have just established the following result.

Lemma 1. *If the STAC threat is implausible (i.e., (PLAUS) is not satisfied) and $t < v(0)$, no bonds are tendered into the STAC offer.*

Therefore, when condition (PLAUS) is not satisfied, STACs are not very interesting. When (PLAUS) is satisfied, then the call threat will be carried out under certain circumstances. Will the call threat always be carried out? The answer to this question depends on whether the average cost of calling the debt is always less than the bond's intrinsic value. Because the bond's value is increasing in the number of bonds tendered, and average call prices are falling in the number of bonds tendered, calling will always be optimal if and only if the following credible commitment condition is satisfied:

$$c(0) \leq v(0). \qquad \text{(CRED)}$$

When the call threat is plausible, i.e. (PLAUS) is satisfied, but the credible commitment condition (CRED) is not satisfied, then the behavior of bondholders will depend on their conjectures regarding the behavior of other bondholders. This dependence leads to multiple subgame equilibria being associated with each tender price.

Lemma 2. *If (CRED) is not satisfied and (PLAUS) is satisfied, then, for each STAC subgame starting with a tender offer $t \in (\chi, v(0))$, there are three symmetric Nash equilibria. In all these equilibria shareholders follow the strategies defined by (CALLPOL). The strategies of bondholders are as follows:*

a. Tendering equilibrium. *At date 0, all bondholders tender into the STAC offer.*

b. Mixed strategy equilibrium. *Each bondholder tenders with probability τ^* where τ^* is a solution to the equation,*

$$\chi \sum_{j=\bar{n}_\tau}^{n-1} \binom{n-1}{i} \tau^j (1-\tau)^{n-1-j} + \sum_{j=0}^{\bar{n}_\tau - 1} \binom{n-1}{i} v(j)\, \tau^j (1-\tau)^{n-1-j} = t.$$

c. Nontendering equilibrium. *At date 0, all bondholders reject the STAC offer.*

Proof. See Appendix.

Thus, when the credible commitment condition (CRED) is not satisfied, a multiplicity of subgame equilibria exist in response to each tender offer price. Nontendering is an equilibrium outcome. If all bondholders are certain other bondholders will reject the offer, then each bondholder will conjecture that the firm will be unwilling to bear the costs of calling the issue in the second stage. Thus, it will also be optimal for each bondholder to reject the tender offer. Tendering is an equilibrium outcome as well. If all bondholders conjecture that other bondholders will tender, each bondholder will believe that, if she holds out, her bonds will be the only bonds that the firm has to call. Because the firm has enough clean cash to call each individual creditor's bonds, each bondholder will conjecture that the shareholders will call her bond. Given the belief that her bonds will be called at the second stage, tendering in the first stage is optimal. In addition to these two pure strategy equilibria, there is also a symmetric mixed strategy equilibrium. Each bondholder tenders with a probability just high enough to make other bondholders indifferent between tendering and not tendering.[8] These three possible bondholder responses to the STAC are depicted in Figure 2. Figure 2 uses the parameters used in Figure 1. The only new parameter is the STAC tender price. This price, t, is set to 0.61 in the example developed for Figure 2. Note that the tender price is between the call price of the bonds, 0.60, and the the intrinsic value of the bonds, $v(0) \approx 0.632121$.

As Figure 2 illustrates, increases in the probability of tendering by other bondholders, initially reduces the incentive of any given bondholder to tender. This effect occurs because tendering by other bondholders lowers the default risk to the remaining bonds and thereby increases their value, making tendering less attractive. In other words, when tendering probabilities are small, tendered shares are strategic substitutes. However, when enough bonds are tendered, the intrinsic value of the bonds increases enough to make shareholders willing to call the issue at date 1 despite equity issuance costs. Thus, the payoff from not tendering, N, eventually starts to decrease in the tendering probability of other bondholders. Thus, at higher average tendering probabilities, tendered bonds become strategic complements. This complementarity ensures that when the tendering probability of other bondholders is high enough, it becomes optimal for each individual bondholder to tender with probability 1. This effect supports the tendering equilibrium. The tendering probability at which the payoff functions for tendering and not tendering intersect (τ_*^{-i} in the diagram) supports the symmetric mixed strategy equilibrium.

[8] Asymmetric mixed strategy equilibria may also exist. No asymmetric pure strategy equilibria exist.

Figure 2. Date 0 bondholder response to a STAC
The horizontal axis represents the probability that other bondholders will tender, τ^{-i}. The line, "N" represents the payout to an individual bondholder from not tendering her bond. The line "T" represents the payout to an individual bondholder from tendering her bond. If $N > T$, the bondholders optimal strategy is not to tender, i.e., $\tau_i^* = 0$. If If $N < T$, the bondholders optimal strategy is to tender, i.e., $\tau_i^* = 1$. If $N = T$, the bondholder is indifferent between tendering and not tendering. In this diagram, the point of indifference is given by $\tau_*^{-i} \approx 0.0630449$. The parameters for this example are as follows: $t = 0.61$, $\chi = 0.60$, $f = 1.00$, $n = 100$, $\iota = 0.10$, $L_0 = 15.00$, $D_0 = 100.00$, cash flows, $\tilde{X}$, are exponentially distributed with mean 100.00.

In contrast to the situation described in Lemma 2, when (CRED) is satisfied, bondholders recognize that, regardless of the tendering decision, nontendered bonds will be called. Thus, the payoff to a hold-out bondholder equals the call price. As long as the tender price exceeds the call price, tendering is the unique optimal strategy for any individual bondholder regardless of his conjecture regarding other bondholders' action. This observation establishes the following result.

Lemma 3. *If (CRED) is satisfied, then, in each STAC subgame starting with a tender offer* $t \in (\chi, v(0))$, *it is the case that, in all subgame perfect equilibira, all bonds are tendered. For the* $t = \chi$ *subgame, a subgame perfect equilibrium exists in which all bonds are tendered.*

Proof. See appendix.

3.2.3 Shareholder date 0 strategies, Nash equilibria of the STAC game

In the previous section, we characterized the equilibria of the subgames starting with a fixed offer. In this section we will consider the shareholders' strategy in setting an initial tender offer price for the STAC offer. The shareholders' objective is to maximize the value of the firm's equity. This objective is equivalent to maximizing the gain from the STAC. The gain from the STAC, Π, is given by

$$\Pi(t, n_\tau) := n \,\min[v(0), c(0)] - \Big(t\, n_\tau + \big(n - n_\tau\big)\, \min[v(n - n_\tau), c(n - n_\tau)]\Big).$$

The second term in the definition of shareholder gains, $t\, n_\tau + \big(n - n_\tau\big)\, \min[v(n - n_\tau), c(n - n_\tau)]$, represents payoffs to bondholders plus the issuance costs of the STAC. The second term, $\min[v(0), c(0)]$, represents the minimum of the value of the debt, $v(0)$, and the outflow from calling the outstanding debt, $c(0)$. A STAC is effective if, in a given equilibrium, that equilibrium produces positive expected gains for the shareholders. In this section we investigate the conditions for an effective STAC. When the call threat is implausible, bonds will not be tendered into the STAC offer at any price less than the intrinsic value of the bonds, $v(0)$. Thus, the STAC cannot be effective. In contrast, when the call threat is credible, the unique equilibrium outcome calls for the firm to retire the entire issue with a STAC tender offer equal to the call price. This result follows because any offer at price greater than the call price is dominated by a tender offer at a smaller price that is also greater than the call price. This fact rules out equilibria in which the STAC price exceeds the call price. In contrast, the intermediate case in which the plausibility condition is satisfied but the credibility condition is not satisfied is very complex. Because multiple subgame equilibria exist for each tender offer price t, in the extended game that includes the shareholders' tender-price decision, there are a huge number of equilibria. For example, suppose bondholders reject all offers less than the midpoint between the call price, χ, and intrinsic value without a STAC, $v(0)$, of the bonds, and accept all higher offers. This bondholder strategy supports a Nash equilibrium in which the shareholders pick a tender price equal to the midpoint between the call price and the intrinsic value. Through similar strategies, any tender price can be the outcome of a Nash equilibrium. These observations are formalized in the next result.

Theorem 1. *The subgame-perfect Nash equilibria of the STAC produce outcomes satisfying the following restrictions.*

a. *If the plausibility (PLAUS) condition is not satisfied, then shareholders gain from employing a STAC is 0.*

b. *If the credibility (CRED) condition is satisfied then the STAC succeeds with probability 1 in inducing all bondholders to tender and the shareholders gain from employing the STAC equals the equity issuance costs associated with calling the bond issue,* $\iota\,(\chi\, n - L_0)$.

c. *If the credibility (CRED) is not satisfied but the plausibility (PLAUS) is satisfied, then any shareholder gain between 0, and the difference between the intrinsic value,* $v(0)\,n$ *and the call value* $\chi\,n$ *is produced by some equilibrium.*

3.2.4 Shareholder strategies and Bondholder coordination

In the previous section, we showed that, when the STAC offer is plausible but not credible, virtually any level of shareholder gain can be supported by a subgame perfect Nash equilibrium. Thus, if we take the attitude that all subgame perfect Nash equilibria are created equal, then we can say very little about the outcome of the STAC offers in the intermediate case of a plausible but not credible call threat. However, as a number of researchers have pointed out, if communication is costless, then we should expect that agents would make use of the opportunity to communicate to make simultaneous, mutually advantageous, "self-enforcing," changes in strategy. By "self enforcing" we mean that no party to the communication has any incentive to double-cross the other communicating parties. Thus, in the presence of costless communication, we should not expect Nash equilibria to stand that are vulnerable to self-enforcing deviations by coalitions of agents. Such equilibria are not "coalition proof" (Berheim, Peleg, and Whinston, 1987).

To elucidate these ideas, consider the following very simple noncooperative game: Students in a class simultaneously and confidentially vote on the grade they will receive, either A, B, C, or D. If all students agree, all students are assigned the agreed upon grade, if there is any disagreement, then all students receive an F. Assuming students preferences are given by grade points, each of the grades, A, B, C, and D, can be supported by a Nash equilibrium in undominated strategies. For example consider the grade of D. If all other students are voting for D then it is the (unique) best response for each individual student also to vote for D holding the votes of the other students fixed. Thus, the "all D" outcome is a Nash equilibrium. However, assuming students are allowed to communicate before they vote (their votes remain confidential) it seems like all students would coordinate to voting to receive an A. Moreover this coordination would be self enforcing in that no individual student, or even subgroup of students, would have any incentive to deviate from the "A-agreement." The same cannot be said for a "D-agreement" as the coalition of all the students would have an incentive to overturn this agreement and replace it with the *self-enforcing* A-agreement. These arguments have been formalized by Bernheim, Peleg and Whinston (1987) in the *coalition-proof Nash equilibrium* concept. Coalition proofness is an appropriate solution concept for noncooperative games (in extensive or normal form) when communication between the parties is unlimited and costless. Coalition proofness is a noncooperative solution concept because it considers only payoff vectors that are self enforcing. Cooperative game theory considers all payoff vectors a coalition can engender.[9]

To the extent that these conditions for the application of coalition proofness, costless and unrestricted preplay communication, are approximated when bondholders confront a STAC offer, the coalition-proof Nash equilibrium concept can provide some insight into the outcomes of a STAC. Moreover, imposing coalition proofness vastly simplifies the characterization of the outcomes of STAC offers. This fact is evidenced by the following result which shows that if attention is restricted to coalition-proof outcomes, a STAC will be effective if and only it is credible.

Theorem 2. *If the credibility condition (CRED) is not satisfied then in every subgame-perfect coalition-proof equilibrium of the game, no bonds are tendered or called; If the credibility condition (CRED) is satisfied, then, in every subgame-perfect coalition-proof equilibrium of the game, all bonds are tendered.*

Proof. See Appendix.

3.3 Implications of the analysis

In Section 3.1 and 3.2, we developed our theoretical model of STACs. In this section we attempt to translate the results of our theory into predictions that we can investigate in the clinical study. First, note

[9] See, for example, Bernheim, Peleg and Whinston (1987), Moreno and Wooders (1996), and Ferreira (1999) for a discussion of these points.

that a key determinant of the outcome of the STAC is the credible commitment condition(CRED). Using simple algebra, the condition (CRED) from Theorem 2 can be reexpressed as follows:

$$\pi \geq \iota(1-\ell) \quad \text{(CRED*)}$$
$$\pi := \frac{v(0)-\chi}{\chi}, \quad \text{intrinsic value premia (over call price),}$$
$$\iota := \text{ costs of external equity issuance per dollar of fund's raised,}$$
$$\ell := \text{fraction of issue call fundable with clean cash.}$$

The key parameters for assessing the satisfaction of credible commitment condition are π, ι, and ℓ. The second key factor identified in the analysis for predicting the outcome of a STAC offer is the potential of bondholder coordination. Conditioned on credibility and coordination, the model can make determinant predictions regarding the outcome of STAC offers. These predictions are given below.

Outcome of STAC	*Credability* $\pi \geq \iota(1-\ell)$;	
Bondholder cordination	YES	NO
YES	STAC suceeds	STAC fails
NO	STAC suceeds	???

Figure 3. Summary of model implications.

All of the implications stated in Figure 3 follow directly from the propositions in the paper. The first row of predictions follows from Theorem 1, the upper right hand corner follows from Theorem 2. The only cell of the matrix in which the outcome is indeterminate is the lower right hand cell. When credible commitment condition is not satisfied and bondholders do not coordinate, both failure and success are consistent with the theoretical analysis. If shareholders are able to make tendering the focal outcome, then tendering by bondholders becomes self-enforcing and this tendering, in turn, renders the shareholders' call threat credible. Thus, STAC success, even when the threat to call is not credible, in face of united opposition is possible. In this case, shareholders have an incentive to try to influence the beliefs of bondholders regarding the actions of other bondholders and the eventual outcome of the STAC. As we shall see in the subsequent cases, such influence attempts actually occurred.

Even though the results of our analysis are for the most part determinant, the predictions do depend on our estimates of coordination and credibility. Thus, for a game theoretic analysis to actually be useful to STAC participants, it would have to be the case that, based on information available at the time of the STAC, these two factors could be assessed by parties involved and the requisite conclusions drawn. To determine if this is possible we must turn to the clinical evidence.

4 Narrative description of four STACs

We now relate the theory developed in Section 3 to outcomes of STAC offers by James River, May Department Stores, and Houston Lighting & Power Company. We were able to obtain extensive narrative data on three of the four STACs, made by these three firms, by searching LEXIS/NEXIS, Dow-Jones New Retrieval, ABI Inform, Business and Industry, and Business Date Line. This narrative information was supplemented with discussions with professionals involved in the STAC offers, e.g., lawyers and expert witnesses. We also supplemented our narrative with information from financial databases. Our clinical analysis is organized as follows. First, we provide the reader with the requisite background information through a narrative description of the four STAC offers. Then we systematically investigate the relationship between the predictions of our theoretical model and the actual outcomes of these four STACS. Table 1 presents a summary of the four STACs analyzed in this section.

4.1 James River

James River, based in Richmond, Virginia, is one of the world's largest pulp and paper products company. In 1990, James River announced a major increase in capital spending to expand the company's core businesses. However, a loss of profitability in the early 1990s, caused by fierce competition in the paper industry significantly delayed implementing plans. In response to the profit slide, management launched a restructuring program that focused on reducing labor and production costs, increasing production of recycled paper products, and entering the private-label business (Espy, 1992).

In 1992, James initiated a complex $613.8 million refinancing program targeting $566.8 million of outstanding debt. As part of this refinancing plan, James issued $200 million 6¾ % notes on October 1. The stated purpose of this issue, according to *Moody's* was to retire its 10¾ % Debentures due 2018.

On September 18, 1992, the company and its financial advisor, Merrill Lynch, announced the STAC and offered to buy $250 million in outstanding 10¾ % bonds. The tender price was $1,093.75, representing a premium of $7.75 over the call price of $1,086.00. The expiration date for the tender offer was September 29, 1992. The STAC did not face strong opposition from bondholders despite the fact that the firm, in essence, admitted, in its report to *Moody's* and in the 10/92 Prospectus (S-2) that it did not have enough clean cash to call the debt issue. In response to the STAC offer, 98 percent of the bonds were tendered. The remaining bonds were called on November 2, 1992. Bondholders were surprised by the STAC, which they viewed as a fundamentally new phenomenon, that they did not understand (Circuit Court of Morgan County, Alabama (CV94-402)).

4.2 May Department Stores

May Department Stores (May), a St. Louis, Missouri-based retailer, is one of the ten largest retailers in the U. S. It operates in 47 states and controls a number of different retail brands. In the early 1990s, May was viewed by the business press as a superior performer (Forsyth, 1993) in a troubled industry. May's corporate strategy combined an increase in corporate focus with an aggressive expansion of its core business. In 1990, May spun off the Venture Stores. In February 1992, the company announced an aggressive expansion plan calling for 85 new stores.

During the first half of 1991, May issued $700 million of amortizing and other debentures at rates of 9 $^1/_2$ % to 10$^5/_8$ % to retire commercial paper debt with higher coupon rates. By late 1991, May Department Stores had $800 million of nonrefundable debt, of which $425 million were contracts with coupon rates over 10%: $250 million in a 10$^3/_4$ % debenture due in 2018 and $175 million in a 10$^3/_8$ % debenture due in 2018. The remaining $375 million debt had rates of 9$^1/_8$ % to 9$^3/_8$ %. May also had three noncallable contracts in the amount of $325 million with interest rates of 9$^5/_8$ % to 9$^7/_8$ %. By the end of September of 1992, May issued $200 million of 8$^3/_8$ % unsecured callable debentures due 2022. The proceeds were to be used for general corporate purposes including capital expenditures and working capital needs, as stated in the information provided to Moody's.

In mid 1992, May and its financial adviser Morgan Stanley, initiated a STAC for the 10$^3/_4$ % bonds. May offered a price of $1,088.50, representing a premium of $2.50 above the call price. It is not clear whether this offer was made public or even carried out. Bondholders, lead by David Bronner, the Chief Executive Officer of ERSA actively opposed this STAC offer. Bronner unsuccessfully tried to discover May's sources of funds for the cash call. He then organized bondholder opposition to the STAC. In the process, he came under intense pressure from Morgan Stanley to accept the tender offer. This pressure was based on the threat to call the issue. A Morgan Stanley employee reportedly told Bronner that the "STAC is coercion, it's a threat—it is standard operating procedure" (Koflowitz, 1993). In another phone conversation, a Morgan Stanley investment banker stated to the bondholders that "you have a right to be mad, but the company can and will call this debt and there is nothing you can do about it" (Koflowitz, 1993). Bronner, however, refused to yield to these threats. In fact, May and Morgan Stanley apparently "blinked" and failed to carry out the threat to call the bonds.

On October 1, May issued $200 million of 8$^3/_8$ % debentures due 2002. The timing of this debt offering aroused bondholder suspicions. These suspicions were exacerbated by May's constantly changing the declared purpose of the issue. When the October issue was first announced, May stated that the purpose of the issue was to retire short-term debt. In the prospectus for the debt issue, May asserted that the proceeds would be used to purchase "other indebtedness," a general term which bondholders felt might include the long-term nonrefundable debt. Later, May informed Moody's that the issue was "for general corporate purposes, including capital expenditures and working capital needs."

Just five days after this $ 200 million new debt issue, May proposed another STAC, this time for the

$10^7/_8$ % issue. The front-end tender price of $1,091.60 represented a premium of $4.50 above the call price. The offer expired on October 20, 1992; any remaining bonds were to be redeemed on November 5, 1992 at a price of $1,087.00. Bronner of ERSA organized the bondholders into a coalition to resist both the new STAC and the earlier STAC for the $10^3/_4$ % issue. Arguing that May did not have the requisite clean cash, the committee wrote to May and the SEC demanding an end to May's efforts to repurchase the two bond issues. In fact, Mr. Thomas Milne, Assistant Director of fixed income for ERSA, communicated the fund's intention to sue May and Morgan Stanley if the bonds were called.

On November 2, the entire 10 $^7/_8$ % issue was called. In response, on December 11, 1992, a civil lawsuit was filed in the Federal District of Montgomery Alabama against May and its investment banker, Morgan Stanley, by a bondholder committee consisting of ERSA, CALPERS, the State of Montana Board of Investments, Erie Family Life Insurance Company, and the John Hancock Sovereign Bond Fund. The suit called for $24 million in compensatory and $100 million in punitive damages (*ERISA et. al. vs. The May Department Stores et. al.*, Case # CV-92-2726, Circuit Court of Montgomery, Alabama). The plaintiffs' case was presented by the law firm of Ritche & Rediker. According to the *Wall Street Journal* (8/23/94) the case was settled in July of 1994 with the plaintiffs receiving approximately $28 million in damages. The official records for the case have, however, been sealed.

4.3 Houston Lighting & Power Company

Houston Lighting & Power Company (Houston), at the time of the offer the eighth largest utility in the U.S., is based in Houston, Texas. The company overexpanded in the 1980s, increasing generating capability by 15 percent while its total megawatt sales of electricity increased by only 8.6 percent (de Rouffignac, 1991). This overexpansion of generating capacity led the firm to cancel a number of power projects in the early 1990s. Houston Lighting & Power Company's parent company, Houston Industries, was at the same time attempting to diversify out of the power and into the cable industry (Brendler, 1988).

Houston's long-term debt as of December of 1991 was $3,632 million, of which $1,480 million was redeemed during the period 1991-1993. Most of the redeemed debt was first-mortgage, callable notes with interest rates ranging from $7^1/_2$ % to $10^1/_8$ %. A $10^1/_4$ % nonrefundable issue (the only bond issue with a clean cash provision) was part of this refunding program. The proceeds for this program came from a $400 million issue of collateralized medium term notes, $146 million of pollution-control bonds with interest rates of $6^3/_8$ % and 6.70%, $100 million of collateralized medium-term notes due 2002 at a rate of 8.15%, $250 million issue of first mortgage $7^3/_4$ % bonds due 2023, $150 million of collateralized medium-term notes due 2003 at a rate of $6^1/_2$ %, and a $350 million preferred stock issue.[10]

[10] The Offer to Purchase reported that these offers were registered with the SEC; however, no report of these issues was found in the *Wall Street Journal*. The preferred stock issue was reported by *Disclosure*.

On September 28, 1992, Houston launched a STAC for its $10^1/_4$ % First Mortgage bonds due in 2019 ($225 million outstanding). The tender offer price was $1091.21, a premium of less than 1% over the call price, and the expiration date for the tender offer was set for October 6, 1992. Bonds not tendered were called on October 28, 1992 at a price of $1084.70. Houston presented its bondholders with all the necessary documents including a notice of redemption clearly stating the source of cash to be used in redeeming the bonds—a "clean" preferred stock issue. The Offer to Purchase stated the reasons for the STAC and the sources of funds for the cash-call. In response to the tender, over 94 percent of the bonds were tendered and the remaining 6 percent were called.

4.4 The James River lawsuit

Not only did the resistance of May's bondholders dramatically affect the outcome of the May STACs, it also appeared to indirectly affect bondholder-stockholder relations at James River. At the time of the James River STAC, some bondholders expressed doubts regarding its propriety. However, no action was initially taken. The resolve of the bondholders grew after the victory of the bondholders in the May case was publicized. The bondholder concerns discussed above became sufficiently salient to induce three major blockholders (Mutual, Transamerica, and Wasserman) of the $10^1/_4$ % issue to file suit, in Morgan County, Alabama. The suit was filed against James River and its advisor Merill Lynch on August 31, 1994 for $50 million in actual and $500 million in punitive damages. In this case as well, Richie & Reciker represented the plaintiffs. As 98% of the bonds were actually tendered into the front-end offer and a call with dirty cash was almost certainly not required, the basis for this action was different from that used in the May's case. The blockholders (primarily insurance companies) argued that a company cannot threaten to call a bond issue subsequent to a tender offer unless it has enough clean cash to call the bonds, even if no bondholders accept the tender offer. They argued that (a) James River did not satisfy this test as it did not have enough clean cash to redeem even half of the issue, (b) James River violated the disclosure requirements of the Trust Indenture Act (Sec. 314), and (c) there was an indirect use of lower-cost debt proceeds (the firm issued $6^3/_4$ % debenture for $200 million on October 1, 1992) whose explicitly-stated purpose was to refinance old debt.

On June 6, 1997, the Circuit Court of Morgan County, Alabama (CV94-402) rejected the arguments of the plaintiffs. The Circuit Court decision was appealed to the Alabama Supreme Court and on April 7, 1998, the Supreme court affirmed the lower court's decision. On June 19, 1998 the Supreme Court ruled again on rehearing to allow the lower court decision to stand in a 4-4 split decision. The concurring opinion rejected the plaintiff's argument that the STAC constituted an indirect use of lower cost debt. The pinion ruled that, because the tender offer was not subject to indenture, the use of lower rate debt was not prohibited. These judges accepted the plaintiff's argument that the STAC exerted economic pressure but concluded that the exertion of such economic pressure did not violate the bond's indenture provision. The dissenting opinion also rejected the plaintiff's argument that the STAC represented an indirect use of lower cost debt to refund the issue. However, the dissenters argued that James River violated the disclosure requirements of the Trust

Indenture Act (Sec. 314) because they did not reveal that they only had 3 million dollars of qualified funds (clean cash) at the time of the STAC.

5 Theory and cases

How the outcomes of these well-publicized STAC offers compare with the outcomes predicted by the theory developed in the previous section? The predictions of our theoretical analysis are contingent on two factors: offer credibility and bondholder coordination. Credibility, in turn, depends on the credit risk of the debt issue, equity issuance costs, and the firm's inventory of clean cash. Coordination depends on the concentration of bond ownership, the ease of interbondholder communication, and less tangible factors such as the leadership abilities and persuasiveness of individual bondholders. Of the two determinants, credibility and coordination, credibility is easier to measure using standard financial-economics data.

Further, as shown by Theorems 1-2, credibility trumps coordination. That is, if an offer satisfies the credible commitment conditions, no amount of preplay bondholder coordination/communication can prevent STAC success. Thus, in cases in which credibility is apparent, the more difficult-to-assess issues surrounding coordination need not be addressed. For this reason, we first investigate the determinants of credibility. If a STAC fails and the credibility conditions are clearly satisfied, then the data contradicts theory. For those STACs in which satisfaction of the credibility condition is problematic, we turn to an analysis of the conditions for coordination.

5.1 Credibility of STAC offers

As shown in Theorem 1, the credibility of a STAC offer depends on the costs associated with the intrinsic call premium on the bonds, the clean cash balance of the issuing firm, and equity issuance costs. First, we individually measure each of these variables for four STACs. Second, we combine the estimates thus obtained to estimate the offer credibility conditions provided in Section 3.2.2.

5.1.1 Credit risk/intrinsic value of the bond

As show in Section 3.2.2, the second key to the credibility of the call threat is "intrinsic value premia," π. The intrinsic value premia represents the premia over the call price that the bond would carry, if it were not callable. Thus, the intrinsic value premia is determined by three factors: the call price, the stated rate of interest on the bond, and the credit risk associated with the bonds. First, we consider measures of each of these factors separately. Next, we compute and explicit estimate of the intrinsic value premia.

As shown in panel A of table 1, the stated interest rates varied from the highest for May, 10 $^7/_8$ %, followed closely by James River, 10 $^3/_4$ % with Houston having the lowest rate at 10$^1/_4$ %. The call prices for the four issues, presented in panel B, were roughly comparable, varying between \$ 1084.7 (Houston) and \$1087.0 (May).

Credit risk assessment is less straightforward than obtaining stated interest rates and call prices. To assess credit risk, we use bond ratings and yield spreads (over similar treasury bonds) as market measures of credit risk. In addition, we estimate interest coverage using times interest earned (TIE) and two traditional accounting-based leverage ratios, long-term debt divided by total assets (LTDTA) and total liabilities divided by total assets (TLTA). The data are obtained from Disclosure and Compustat for three years preceding (pre) and three years following (post) the STAC announcement. We report 3-year averages for each of these measures for the pre- and post- announcement periods. Credit risk measures are presented in table 2.

The credit risk premia (yield spreads) and bond ratings, reported in panel A of table 2, indicate that James is the riskier of the three firms and that May and Houston are in the same risk class. Further, interest coverage and leverage measures for the pre-announcement period, shown in panel B, indicate that the credit risk associated with James is greater than that of Houston. Other comparisons are less obvious. For example, May has higher LTDTA ratio than Houston, but other measures appear to be similar to those of Houston.

Using the measures given above, it is not possible to rank the intrinsic value premia for the four issues. May has the highest stated interest rate, pointing to high intrinsic value premia, but this is countered by higher call prices and fairly high credit risk, factors leading to lower intrinsic value premia. Houston's issue has the least credit risk; however, it also has the lowest stated interest rate. The ranking for James is equally unclear. Thus, to obtain a satisfactory estimate of intrinsic value premia, we turn to an explicit computation that weighs all factors that determine the intrinsic value premia. The procedure we utilize is based on the following logic: the market price of a bond represents the intrinsic value of the bond less the value of the redemption option held by equity holders. The value of the redemption option on nonrefundable debt must be no less than zero and no greater than the value the redemption option would have been if the debt were callable without a nonrefundability restriction. Thus, we estimate the intrinsic value premia as follows. We take the market value as the lower bound on the intrinsic value of the bond. We take as the upper bound the market value plus the value of the call option on a standard refundable call issue. We use a binomial option pricing model similar to Kalotay, Williams and Fabozzi (1993) to estimate the value of the embedded call option. The volatility of the forward 1-year rates is assumed to be 10 percent. The intrinsic value premia, p is computed as [(Market value of bond + value of the embedded call option) divided by STAC call price] - 1. The value of the embedded call option, the lower and upper bounds for bond intrinsic value and the intrinsic value premia are presented in table 3.

The lower and upper bound intrinsic value premia for May is higher than the premia for either James or Houston suggesting that the higher stated interest rates for May more than offset the lower credit rating and higher call price. In contrast, the intrinsic value premia estimated for James and Houston are roughly comparable. Thus, our analysis indicates that May had much more to gain from calling its outstanding debt than either James or Houston. This fact, ceteris paribus, points to a higher degree of credibility for the May

STAC threat than for the other two STACs. However, the intrinsic value premia must be weighed against the equity issuance costs and the size of the required equity issue before we can make an overall judgement of credibility.

5.1.2 Clean cash flow inventory

Another key determinant of the credibility of the STAC offer is the clean cash balance available for redeeming the call issue. The larger this balance, the more credible the call threat. A point of dispute in the legal cases surrounding the STAC is the degree to which the current cash balance, which might have been produced by debt issues in earlier years is "clean." Based on conversations with expert witnesses, there seems to be no established bright-line test for determining the extent to which current cash flows are clean. Thus, we estimate both an upper and lower bound for clean cash flows. At most 100 % of the cash balance at the start of the year prior to the STAC and the net changes in the cash balance over the year is clean. This amount plus, clean issues of new securities (equity plus preferred) constitute an upper bound on clean cash. This argument motivates the following definition:

Upper bound:

Clean Cash Flow = Max[Cash balance + operating cash flows - investments, 0]
+ recent equity issues + recent preferred stock issues,

where for the purposes of the formula, recent is defined to one year before the STAC.

On the other end, at the very least, the firm's clean cash balance should equal the proceeds of equity and non prohibited preferred stock immediately before the STAC offer. Thus we estimate our lower bound for clean cash as follows:

Lower bound:

Clean Cash Flow = Proceeds from recent equity issues + proceeds from recent preferred stock issues,

where recent is defined to be within the one-year prior to STAC.

The values for both definitions for each of the STACs as well as the fraction of the bond issue that it covers are presented in Table 4. The analysis reveals a clear hierarchy with respect to the ability of the three firms to fund the call with clean cash. Houston can fund the largest issue fraction, followed by James River and, then May. Houston has enough clean cash to at least pay for up to 49% of the issue using the lower bound clean cash definition and certainly all of the bond issue using the upper bound clean cash definition. James only has clean cash to cover 40% to at most 69% of the bond issue while May does not have enough clean cash under our definitions. This quantitative evidence is also consistent with the qualitative evidence from the narratives, i.e., both James River and May provided a less than complete explanation of sources of funding for the redemption while Houston provided detailed fund source information. Ceteris paribus, the ordering of clean cash balances, indicates that Houston's call threat was the most credible, while May's was the least credible.

5.1.3 Equity issuance costs

Our issuance cost estimate captures total issuance costs per dollar of new equity issued. This proxies for the ι variable developed in the theory section. We estimate this parameter following the approach used in Lee, Lockhead, Ritter, and Zhao (1996) for IPOs. Equity issuance costs are the sum of cost of equity dilution, gross spread fees, reallowance fees, underwriter fee, and all other issuance related expenses. To compute the dilution cost associated with equity issuance, we collect information from SDC database on all the SEOs issued by firms within each STAC's industry (based on a 4-digit SIC code) for the period 1/1/91 to 12/31/93. The 1-day price drop obtained is similar to the stock price reaction found by Asquith and Mullins (1986), Masulits and Korwar (1986), and Smith (1986). The equity dilution cost is the percentage drop in stock price on the day of SEO announcement times the fraction of market value before SEO to the amount of issue. Gross spread fees and other issuance costs are obtained from the SDC new issues database for the same firms used to compute the dilution costs. Our estimates of these direct costs are similar to the total direct costs in Lee et al (1996). The estimates of equity issuance costs are presented in the last column of table 4. We obtained the following estimates, for May 15%, for James River 18.4% and 2.2% for Houston Power & Light.

The estimates for James River and May are roughly comparable in magnitude with the equity issuance costs estimate used in Chacko, Tufano, and Verter (1999). The issuance cost estimates for Houston Power and Light are much lower. This is consistent with the literature documenting lower equity dilution costs for regulated utilities (Masulis and Korwar, 1986 and Smith, 1986) and lower total direct costs (Lee et al, 1996).[11] Note also that, May's willingness to subject itself to possible losses from a law suit, rather than eliminate the risk through an equity issue provides "revealed preference" evidence in favor of high equity issuance costs.

In summary, it appears that both James River and May faced significant equity issuance costs, while Houston Power & Light faced much lower costs. Ceteris paribus, this implies that making the call threat credible will be a much more difficult proposition for James River and May than for Houston.

5.1.4 Overall credibility

As can be seen from the earlier analysis, the components of credibility—intrinsic value premia, equity issuance costs, and clean cash balance—do not rank the STAC issues the same way. Thus, we cannot compare

[11] Our estimates of equity issuance costs for James River and May are an order of magnitude greater than the announcement effects of new equity issues. This difference is explained by the fact that the announcement effects are obtained by dividing losses by the total value of all outstanding equity, instead we divide rather by the total value of the new issue, usually a much smaller number.

the overall credibility of the STACs without aggregating these three measures. More importantly, we need more than a relative ranking to determine offer credibility. We must explicitly compare the components of the credibility equation if we are to see whether the conditions for offer credibility for each of the STACs, given in the previous section, are satisfied. Table 5 presents this information.

By Theorem 1, whenever π, exceeds $(1-\ell)\iota$, the the call threat is credible. Because we have two estimates of intrinsic value premia and two estimates of clean cash, we have four estimates of the credibility condition for each firm.

Under two of the four estimates, credibility is satisfied for the Houston STAC. This fact combined with Houston's willingness to document its sources of funding for the call (in sharp contrast to May and James) leads us to believe that the credibility condition was satisfied in the case of Houston. The credibility condition is never satisfied for the James River or May STACs. Thus, both the narrative histories as well as our analysis lead us to believe that the crediblity condition was not satisfied in the case of James or May.

Our results for overall credibility can be summarized as follows: Houston had relatively little to gain from calling non-tendered bonds given their relatively low coupon rate. However, because of the very low equity dilution costs (perhaps because of its regulated industry status) and large clean cash reserves, it had even less to lose. Thus, its call threat appears credible. In contrast, May had a great deal to gain relatively from calling its debt given the very high coupon rates, however, May also had even more to lose from calling with new equity because of very high dilution costs and a lack of clean cash reserves. Thus, the May threat was not credible in the face of coordinated bondholder resistance. James River, with equally high equity issuance costs and a lower coupon rate than May, had less to gain then May from calling, and approximately the same amount to lose from equity issuance. Thus, James's threat to call was even less credible.

5.2 Bondholder coordination

As discussed earlier, in the case of Houston, the credible commitment condition appears to be satisfied. When the credibility condition is satisfied the offer should succeed regardless of bondholder efforts to coordinate opposition. Thus, assessing bondholder coordination is probably not important in Houston case. In contrast, in the case of May and James River, the satisfaction of the credible commitment condition is highly problematic. For this reason, it is important, in the case of these two firms, to assess the degree of coordination between bondholders.

Assessing coordination is difficult. The coordination required to resist the STAC consists of self-enforcing pattern of resistance. This pattern of resistance does not require any explicit communication between bondholders. As the earlier case studies documented, resistance was observed in the May case and not in the case of James River.

Is this the outcome that would have been expected given the theory developed in the previous section? To answer this question we need some ex ante measure of the likelihood of effective bondholder coordination. Support for the predictive power of the theory will be found if resistance is observed only when the STAC fails to satisfy the credibility condition and ex ante, coordination is predicted. What factors predict coordination between creditors. While there is no compelling theoretical argument in this direction, a number of researchers have provided evidence that concentration of creditor interests is a valid proxy for the likelihood of effective creditor coordination (Gilson, John, and Lang, 1990). It is also plausible, that creditors are more likely to oppose shareholders in a coordinated fashion when they have more to lose from the shareholders action. With these criteria in mind, we consider consider coordination by the bondholders of May and James River.

5.3 Coordination at James River

The intrinsic value premia is about 2% for James River. Moreover, the the ownership of bonds targeted in the James STAC was very diffuse. The largest blockholder, Occidental Life Insurance held only 6% of the issue and no other bondholder held more than 2% of the issue. Thus, the ownership of this bond issue was more diffuse than is typical for corporate bond issues. Our earlier empirical analysis of offer credibility indicates that the offer-credibility condition was not satisfied in the case of the James STAC. The results of our theoretical analysis predict that when the offer credibility condition is not satisfied, and bondholders fail to coordinate, STACs can succeed. The low concentration of bond holdings and the relatively low "stakes" of the James STAC, indicate less than optimal conditions for blockholder coordination. Thus, the success of the STAC in the case of James River is certainly not surprising given our earlier theoretical analysis.

5.4 Coordination at May

With regard to the conditions for coordination, the situation at May is almost exactly opposite the condition at James River: The stakes were high as shown by table 5, with intrinsic value premia of at least 4.65% and all estimates are at least double the comparable estimate for James River. In addition, the ownership structure of May bonds was fairly concentrated. In fact, ownership of the first issue targeted by May, the 10 3/4 % issue was extremely concentrated. The Employee Retirement System of Alabama (ERSA) owned 55.6 % of the issue; California Public Employees Retirement System (CALPERS) owned 10% of the issue with the remainder of the issue being more widely held. The extreme concentration of ownership in the hands of sophisticated investors, represents an extremely fertile environment for effective preplay communication. Our model predicts, that the when credibility condition is not satisfied, and bondholders coordinate their actions, STACs will fail.

Ownership of the second issue targeted by May, the 10 3/8 % issue was somewhat less concentrated. ERSA, leader of the resistance to the 10 3/4 % issue, owned only 0.86% of this issue. CALPERS, a participant in the resistance to the May's earlier STAC, owned 14.9% of the issue favored resistance. The other large owners were State of Montana Board of Investments, Erie Family Life Insurance Company, the John Hancock Sovereign Bond Fund, Transamerica, Occidental Life Insurance, Washington State Investments Board, and New York Life Insurance.Thus, the conditions for coordinated resistance were favorable for both STACs. As documented earlier, the credible commitment condition was probably not satisfied for either bond issue. Thus, by Theorem 2 we should expect coordinated resistance to the STAC and this is exactly the pattern of behavior we observe.

6 Conclusion

This paper investigated, both from a theoretical and clinical perspective, Simultaneous Tender and Calls (STACs) offers. A STAC is a front-end tender offer accompanied by a threat to call nontendered bonds. We argue that the STAC phenomenon, although very much a product of the financing environment of the late 1980s and early 1990s, nevertheless provides significant insight into the ability of game-theoretic models to explicate the concrete details of actual corporate strategic maneuvers. Issues raised by theory, including the ability of firms to commit to financing policies, the ability of bondholders to coordinate their actions and intervene in a strategic fashion, and the magnitude of the losses faced by firms from equity issuance seemed to play a determining role in the outcomes of the four STACs.

Of course, on cannot prove that the usefulness of game theoretic modeling in the case of STACs ensures that it will prove useful in modeling other clinical strategic interactions. In fact, STACs are straightforward grist for the mill of strategic analyses. However, this sort of straightforward problem is exactly the place to begin the investigation of practical applicability of game theory to corporate financial strategy. Just as the clinical analysis of real options problems started with the study of real-world problems well tailored to the analytical tools then at hand (e.g, Paddok and Smith, 1988) and has now moved on to tackling much less tractable problems (See Moel and Tufano, 1998) so, hopefully this paper will represent the beginning of a trajectory of research that integrates rigorous analysis of incentives and the rich texture of actual business practice in attempting to explicate strategic maneuvers in business with structured analytical modeling.

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Appendix

Proof of Lemma 2. In order to establish (a), we need to show that is is optimal for each individual bondholder to tender if if all other bondholders tender. If all other bondholders tender, then the intrinsic value of a lone-holdouts bond will equal $v(n-1)$. Because (PLAUS) is satisfied by assumption, the shareholders' payoff is higher if he redeems this lone holdout bond. Thus, in any subgame-perfect Nash equilibrium, the holdout bond will be redeemed. Given redemption, the payoff from holding out is the call price, χ; this payoff is strictly less than the payoff from tendering, which is given by the tender price, t. Thus (a) is established.

Next consider (b). Define the function

$$f(\tau) := \chi \sum_{j=\bar{n}_\tau}^{n-1} \binom{n-1}{i} \tau^j (1-\tau)^{n-1-j} + \sum_{j=0}^{\bar{n}_\tau - 1} \binom{n-1}{i} v(j)\, \tau^j (1-\tau)^{n-1-j} - t, \quad \tau \in [0,1]$$

Note that f is a polynomial function and is thus continuous. Note also that $f(0) = v(0) - t > 0$ and $f(1) = \chi - t < 0$. Thus, by the intermediate value theorem, there exists, τ^* such that $f(\tau^*) = 0$. We claim that all bondholders tendering with probability τ^* and rejecting the offer with probability $1 - \tau^*$ is a subgame-perfect equilibrium. To see that this is the case, note that, if all other bondholders tender with probability τ^*, the difference in between the payoff to an individual bondholder from tendering and not tendering is given by $f(\tau^*)$. The fact that $f(\tau^*) = 0$ thus implies that each bondholder is indifferent between tendering and not tendering given that all other bondholders tender with probability τ^*. Thus, we have established (b).

Finally consider (c). We need to show that if no other bondholders tender, each bondholder is at least weakly better off not tendering. To see this, note that if no bondholders tender then, by (CRED), the shareholders will not call the bond issue in subgame-perfect equilibrium. Thus, the payoff from rejecting the tender offer is $v(0)$. This exceeds, by the conditions of the Lemma the payoff from tendering, which is given by t. Thus (c) has been established. □

Proof of Lemma 3. Note first that if (CRED) is satisfied, then regardless of how bondholders respond to the STAC offer, all outstanding bonds will be redeemed. Thus, the payoff from rejecting the offer is the call price, χ. The payoff from accepting the tender offer is $t > \chi$. Thus, in every subgame-perfect equilibrium, all bonds are tendered. □

Proof of Theorem 2. Suppose the credibility condition (CRED) is not satisfied. For any given subgame starting with an offer price less than the market price, $v(0)$, Theorem 1 shows that the outcome in which no bonds are tendered is strictly preferred subgame equilibrium by all bondholders. This equilibrium is also a Strong Nash equilibrium of the subgame, as no bondholder coalition can deviate from equilibrium strategies to attain a higher payoff. Thus, it is coalition proof. On the other hand, mixed strategy and pure strategy tendering equilibria produce a payoff to all bondholder of t, which is strictly less than the payoffs in the Strong Nash equilibrium of the subgame in which no bonds are tendered, $v(0)$. Because strong Nash equilibria are always self-enforcing for a coalition of the whole bondholder set (Bernheim, Peleg and Whinston, 1987), this implies that all tendering and mixed strategy equilibria are not coalition proof in the subgame starting with a tender offer. Thus, in a coalition proof extensive form equilibria, the offer price fails in any coalition-proof subgame equilibria starting with a tender price $t < v(0)$. Further, a tender offer at the market price, $v(0)$, lowers the payoffs of the shareholders because of issue costs. Thus, it will not be attempted by shareholders. Thus, no bonds will be tendered or called in an extensive-form–coalition-proof equilibrium. □

The proof of the second assertion of the theorem—that all bonds are tendered if (CRED) is satisfied—is straightforward. It follows because by Lemma 3, at any tender price $t > \chi$, all bonds will be tendered into the STAC offer. To obtain a contradiction, consider a subgame-perfect equilibrium in which not all bonds are tendered. By the previous observation, in such an equilibrium the tender price is given by $t = \chi$. However, for all $\epsilon > 0$, the shareholders can ensure that all bonds are tendered by offering the tender price of $\chi + \epsilon$. For ϵ sufficiently small, these tender offers will produce a higher payoff to the shareholders than the payoff in the proposed equilibrium in which not all bonds are tendered. This fact contradicts the existence of such a subgame-perfect Nash equilibrium. □

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