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TAKEOVER DEFENSES AND SHAREHOLDER VOTING*

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Abstract

Why do shareholders vote for anti-takeover devices which apparently lower the value of their firm? We address this question by constructing an agenda-setting model in which rational, informed, and value-maximizing shareholders vote on requests for such devices made by a self-interested management with employment opportunities outside the firm. We find sufficient conditions for the value of the firm to decline as a result of a request, although it is approved by shareholders. In our model, the apparently paradoxical voting behavior occurs because the expected takeover premium is reduced more by rejection of the request than by approval.

Abstract

Why do shareholders vote for anti-takeover [illegible] which appear to lower the value of their firm? We address this question by constructing a [illegible] model with asymmetric information, and value-maximizing [illegible] proposals [illegible] designed [illegible] by a self-interested management with [illegible] the [illegible] conditions for the value [illegible] of a [illegible] although it is [illegible] shareholders. In our model [illegible] voting behavior [illegible] expected takeover premium is reduced [illegible] by rejection of the [illegible] than by approval.

1. Introduction

Why do shareholders vote for anti-takeover devices which apparently lower the value of their firm? We address this question by constructing a model in which rational, informed, and value-maximizing shareholders vote on requests for such devices made by a self-interested management with employment opportunities outside the firm. We describe conditions under which the value of the firm declines as a result of the request, although it is approved by shareholders. In our model, the apparently paradoxical voting behavior occurs because the expected takeover premium is reduced more by rejection of the request than by approval.

A large and increasing number of amendments to corporate charters are specifically designed to increase the cost of transferring control. DeAngelo and Rice (1983) report over 250 proposed amendments in 1974 through 1979. Linn and McConnell (1983) find generally increasing incidence of such proposals among NYSE firms over the period from 1960 to 1980. The Investor Responsibility Research Center lists over 200 in 1985 alone. The two major hypotheses describing the motives for instituting anti-takeover charter amendments are commonly described as "management entrenchment" and "shareholder interests."[1] According to the management entrenchment view, incumbents are interested in job security and seek protection from the takeover market, to the detriment of shareholders. Two suggested explanations for shareholder approval of entrenching antitakeover devices are: (1) for a majority of shareholders, the costs of becoming informed about the effects of defensive charter amendments exceed any potential benefits, and uninformed shareholders consistently give their proxies to management; and (2) large shareholders wish to maintain friendly relations with management to ensure the benefits of future business, and large shareholders control sufficient shares to be pivotal in the vote. Shareholder irrationality is sometimes offered as a third alternative.

The stockholder interests hypothesis recognizes a free-rider problem in collective action by shareholders (Grossman and Hart (1980), Jarrell and Bradley (1980)). Shareholders have difficulty colluding to extract larger premia from takeover bidders, so antitakeover devices benefit shareholders by enforcing a level of collusion in takeover negotiations. Since defensive charter amendments benefit shareholders, there is no inconsistency in rational shareholders voting for them. However, there is little evidence that shareholders benefit from such amendments. DeAngelo and Rice (1983) find statistically insignificant negative abnormal returns around the public announcement of proposed antitakeover amendments. Linn and McConnell (1983) find positive returns around the board meeting date at which amendments are proposed, and insignificant negative returns around the proxy mailing date. Jarrell, Poulsen and Davidson (1985) find negative returns accompanying the announcement of "shark repellents", *viz.* supermajority, classified board and authorized preferred amendments.

In the context of our model, the management entrenchment and shareholder interests hypotheses do not necessarily lead to different predictions about shareholder value. Anticipatory takeover defenses raise the costs of acquiring control of the firm, thereby entrenching management, but lead to a higher premium for shareholders if a bid succeeds. We presume that different potential managers contribute different value-added to a given firm, by virtue of skill or experience. Only managers capable of producing higher value-added than the incumbent can mount successful takeover bids. Whether shareholders gain or lose as a result of the incumbent's defenses depends upon the quality of the incumbent management relative to potential bidders, and the incumbent's opportunities for employment outside the firm.

The paper is organized as follows. In section 2 we develop the model, and we summarize and discuss the results in section 3. Section 4 concludes. All proofs are confined to Appendix A. Appendix B consists of an example that illustrates our results.

2. Model

We are interested in managerial control of a given firm with fixed assets and financial structure. There is a continuum **M** of different managerial types capable of running the firm, different types contributing differently to the value of the firm. A manager's type is the common expectation of owners and the outside market of the value added to the firm by that manager. Let $m \in \mathbf{M}$ denote the incumbent manager's type, and assume **M** is the whole real line.[2] The distribution $F(\cdot)$ of types on **M** is common knowledge and induces a distribution over possible values of the firm in question. Because we take the value of the assets and the financial structure to be fixed, we can, without loss of generality, let $F(\cdot)$ also describe the distribution over managers of possible firm values. Assume that the support of F is connected, and that F is smooth. Let $f(\cdot)$ be the density function. We additionally assume that $\lim_{t \to \infty}[1-F(t)]/f(t) < \infty$: this is not a strong restriction.[3]

The firm is owned by a set of shareholders holding fully diversified portfolios. Being fully diversified, each shareholder is interested only in maximizing the expected value of the firm. This expected value depends both on the incumbent manager's type and on the expected premium paid to the owners, conditional on the firm being taken over by some alternative management.

Heuristically, the model of takeovers we have in mind is the following. The lifetime of the firm is two periods. A manager of type m currently controls the firm. In the second period, nature draws a potential alternative manager from the set **M**, who can choose whether or not to make a takeover bid for the firm. Since there are no takeover bids possible beyond the second period, the maximum value of the firm in this last period is given by the value added by the manager then in control, i.e. the second period manager's type. We suppose that there is no utility value to making a bid *per se*, so that, given the incumbent manager's type m, only managers of types $n > m$ could find it worthwhile to make any takeover bid. If there is any cost to bidding, then no type $n \leq m$ will make an offer. Hereafter, we assume there is such a cost, but, to avoid cluttering the notation unnecessarily, suppose the cost constant and take it to be implicit in the value of m. Hence, given the distribution F, the probability that a manager minimally capable of making a takeover bid arrives is [1-F(m)] (if we make the bidding-cost explicit, we would have to write [1-F(m+ε)]: this adds nothing). The qualification "minimally" here refers to the possibility that the incumbent will contest any bid by erecting takeover defenses: being a manager of type n > m is necessary but not sufficient for making a successful bid for the firm. If a bid is made and is successful, then the new manager controls the firm for the remainder of its life. If there is no bid or if there is an unsucessful bid, the incumbent remains in control.[4]

Given this model of takeovers, the first period expected value of the firm is simply the sum of the incumbent manager's value added, m, and the expected premium in the second period. Without loss of generality, let discount factors be equal to one for the manager and all shareholders. To derive this expected premium, consider first the incumbent manager's objective function. Since he is surely in control of the firm in the first period and the investment and financial structure of the enterprise is taken as given, it is necessary only to examine his second period payoff.

The manager is endowed with two control variables, x and y, both takeover defenses. We view such defenses as effectively increasing the cost of making a successful takeover bid. It is natural, then, to describe both types of defense as nonnegative real variables: $(x, y) \in \mathbf{R}_+^2$. In the absence of any defense, managerial types n > m will successfully bid for the firm: if there is any defense, a successful bidder must be capable of overcoming the defenses in addition to improving on m. Therefore, given defenses x and y, a takeover bid must be at least equal to [m+x+y] in order to win. As yet there is nothing to distinguish the two types of defense and, indeed, from any potential bidder's perspective the two sorts are indistinguishable. They are, however, quite different from the incumbent manager's perspective.

Defense x is <u>anticipatory</u>: it can be put in place <u>only</u> in the first period, prior to any potential bidder appearing. There are no direct costs to implementing x. However, the manager is obliged to ask the shareholders explicitly for a level of x. Majority voting among the shareholders determines whether or not the manager's request is granted. Amendments are not permitted, and so the shareholders can only accept or reject the manager's proposal.[5] In addition, there is an indirect cost borne by the manager for requesting anticipatory defense, irrespective of whether this request is granted. This cost is in terms of his outside value - the utility payoff he can expect to receive in the second period, conditional on being ousted from the firm. Our presumption is that efforts on the part of incumbent managers to erect takeover defenses in the absence of an explicit offer is an indication that the manager is, for instance, more interested in personal security than the welfare of the shareholders; and this lowers his outside market value. Let x? denote a request for a level of anticipatory defense. If x? is approved by shareholder vote, then the implemented level of this defense is x = x?; and if it is not approved then x = 0. Evidently, x? = 0 implies x = 0. Note however that the above discussion implies that the states of the world [x = 0 | x? = 0] and [x = 0 | x? > 0] are distinct: this is crucial to our model.

The second type of takeover defense available to the manager, y, is responsive: it is implemented only to fight an explicit takeover bid in the second period, conditional on such a bid materializing. Unlike anticipatory defenses, the manager is free to implement any level of responsive defense without the necessity of obtaining shareholder approval. There are, though, direct costs to engaging in a takeover fight. Let c(y) be the direct costs, measured in units of utility, borne by the incumbent management in implementing a responsive defense of y: assume $c(0) = 0$, $c'(y) > 0$ and $c''(y) \geq 0$ for all y. For technical reasons, it is convenient to assume $\lim_{y \to 0} c'(y) = 0$: none of our principal results depend on this.[6, 7]

In the heuristic discussion of the takeover process above, given defenses x and y, we argued that any successful bidder in the second period must pay at least [m+x+y] to acquire the firm. Will any more be paid? Because shareholders are interested only in maximizing wealth, it is sufficient to pay $\varepsilon > 0$ more than [m+x+y] to persuade them to remove the incumbent. No acquirer wishes to pay any more than necessary to take over the firm. Therefore, in the limit, epsilon will be zero.

Hence, the premium over and above his managerial type, m, that the incumbent secures for the shareholders -- conditional on losing a takeover battle in the second period despite defenses x and y -- is precisely [x+y]. Moreover, again taking x and y as fixed, only managerial types of n > [m+x+y] will make offers, and any such offer will be successful. The probability of takeover in the second period is therefore given by [1 - F(m+x+y)].

Given x and y, the net second period utility the incumbent obtains, conditional on losing control of the firm, is given by:

(1) $\omega(x, y \mid x?) = W(x+y, x? \mid m) - c(y)$,

where $W(\cdot)$ is the manager's gross outside value given x, y and x?. Assume $W_1 > 0$, $W_2 < 0$, $W_{11} < 0$ and $W_{12} \leq 0$. We also assume that $\lim._{x? \to \infty} W_2 = -\infty$. Thus the incumbent's outside value conditional on losing his current position, is increasing concave in the takeover premium he was able to extract from the acquirer; decreasing -- ultimately, at an ever-increasing rate -- in any efforts to secure anticipatory defenses in the first period; and the cross-effects of this latter on the former are non-increasing. Assume also that $W(0, 0 \mid m) > 0$.

If there is no takeover bid in the second period, the manager stays in control and receives a utility V(m). To make the problem nontrivial, we suppose $V(m) > W(0, 0 \mid m)$.

We argued above that, given x and y, if there is a bid then it will be successful. At the beginning of the second period, the anticipatory defense x is indeed given. However, since defense y is responsive, the manager's selection of y will depend, *inter alia*, on the particular managerial type n who makes the takeover attempt. The incumbent's utility and cost schedules are presumed common knowledge, as is his type. Likewise, once nature has made her draw, the type of the potential bidder in the second period is common knowledge. Therefore, any potential bidder of type n is capable of calculating the incumbent manager's optimal credible response y to a bid by n. If this response is sufficient to beat n's best offer, then -- because of the bidding cost and the presumption of credibility -- n will make no offer at all. If n is capable of topping the incumbent's best response, then n will make the smallest offer necessary to win control of the firm. And even though the incumbent loses surely, by definition of credibility he will bear the costs of fighting, c(y), and the winner will pay the premium [x+y]. Hence the earlier argument goes through. It remains to determine the set of credible responsive defenses.

Let x? and x be given, $x \in \{0, x?\}$, and define:

(2) $y^*(x \mid x?) = \text{argmax.}_{y \in \mathbf{R}_+} \omega(x, y \mid x?)$.

From (1), we obtain:

(3) $\partial\omega/\partial y = W_1 - c'$;

(4) $\partial^2\omega/\partial y^2 = W_{11} - c'' < 0, \forall y$.

Setting $\partial\omega/\partial y = 0$ implicitly defines $y^*(x \mid x?)$. By (4), $y^*(\cdot|\cdot)$ is unique for all x?, $x \geq 0$. Since $W_1 > 0$ and $\lim._{y \to 0} c'(y) = 0$ by assumption, $y^*(\cdot|\cdot) > 0$.

We now define, $\forall n \geq x+m$:

(5) $v(n, x \mid m) = V(m) - c(n-x-m)$.

The schedule $v(\cdot)$ describes the maximum second period utility the incumbent manager can obtain, given he fights and defeats any bidder of type n (again, no managerial type $n' \leq x+m$ will make an offer). Define, for $x? \geq 0$ and $x \in \{0, x?\}$:

(6) $\underline{n}(x \mid x?) = [\inf.n \mid v(n, x \mid \cdot) = \omega(x, y^*(x \mid x?) \mid x?)]$, if $V(m) > W(x+y^*(x \mid x?), x? \mid m)$;

$[\inf.n \mid V(m) = W(n-m, x? \mid m)]$, otherwise.

(Notice that, because $V(m) > W(0, 0 \mid m)$ by assumption, $\underline{n}(x \mid x?) > m + x$ for all x, $x? \geq 0$). Then for all types $n \leq \underline{n}(x \mid x?)$, it is credible that the incumbent manager m will fight and defeat the bid. On the other hand, any bidder of type $n > \underline{n}(x \mid x?)$ will make a successful offer for the firm, although the premiums they have to pay will differ.

To see how premiums paid to successful bidders vary, define, for $x? \geq 0$ and $x \in \{0, x?\}$:

(7) $n^*(x \mid x?) = x + y^*(x \mid x?) + m$.

There are two cases: (a) $n^*(x \mid x?) > \underline{n}(x \mid x?)$ and (b) $n^*(x \mid x?) \leq \underline{n}(x \mid x?)$: case (a) occurs if and only if $V(m) < W(x+y^*(x \mid x?), x? \mid \cdot)$. Figure 1 illustrates these under the assumption that $x = x? \geq 0$.

[FIGURE 1 ABOUT HERE]

Consider Figure 1(a) and let $n \in (\underline{n}(x \mid x?), n^*(x \mid x?)]$. Then it is a best response for the incumbent manager first to fight n to extract (virtually) all n's willingness-to-pay for the firm, and then to leave the firm to collect his net outside value, $\omega(x, n\text{-}m\text{-}x \mid x?)$: this is clearly credible. Now let the bidder-type exceed $n^*(x \mid x?)$: then again the incumbent will optimize by fighting to extract a premium, in this case (virtually) equal to $[n^*(x \mid x?) - m]$, and then leaving the firm and obtaining his outside value, $\omega(x, n^*(x \mid x?)\text{-}m\text{-}x \mid x?)$.

Notice in this last case that bidders do not pay all that they are willing to pay for the firm. In this event, although the maximum value of the firm is n in the second period, the new manager is assumed to consume the surplus, $n - [n^*(\cdot \mid \cdot) - m]$. Since the life of the firm is only two periods, this is reasonable. If one thinks of the new manager as representing some other firm, then this surplus may be viewed as a windfall gain to the owners of the acquiring firm.

In Figure 1(b), the situation is analogous to the second case described for 1(a). All successful bidders pay a premium of $[n^*(x \mid x?) - m]$, irrespective of their type, and only types $n > \underline{n}(x \mid x?)$ will make takeover bids.

For future reference, for all $n > \underline{n}(x \mid x?)$ and for any $x \geq 0$, let $\pi(n, x \mid x?)$ denote the premium actually paid by the successful bidder of type n. Then for any successful bid, the premium paid over m is:

(8) $\pi(n, x \mid x?) = \min.[n - m, n^*(x \mid x?) - m]$.

We are now in a position to specify the incumbent manager's second period expected payoff schedule as a function of anticipatory defenses, x:

(9) $$U(x \mid x?) = F(\underline{n}(x \mid x?))\cdot V(m) + \delta\cdot[F(n^*(x \mid x?)) - F(\underline{n}(x \mid x?))]\cdot\int_{\underline{n}}^{n^*} \omega(x, n\text{-}m\text{-}x \mid x?)\cdot f(n)dn$$
$$+ \{\delta\cdot[1\text{-}F(n^*(x \mid x?))] + [1\text{-}\delta]\cdot[1\text{-}F(\underline{n}(x \mid x?))]\}\cdot\omega(x, n^*(x \mid x?)\text{-}m\text{-}x \mid x?)$$

Figure 1(a)

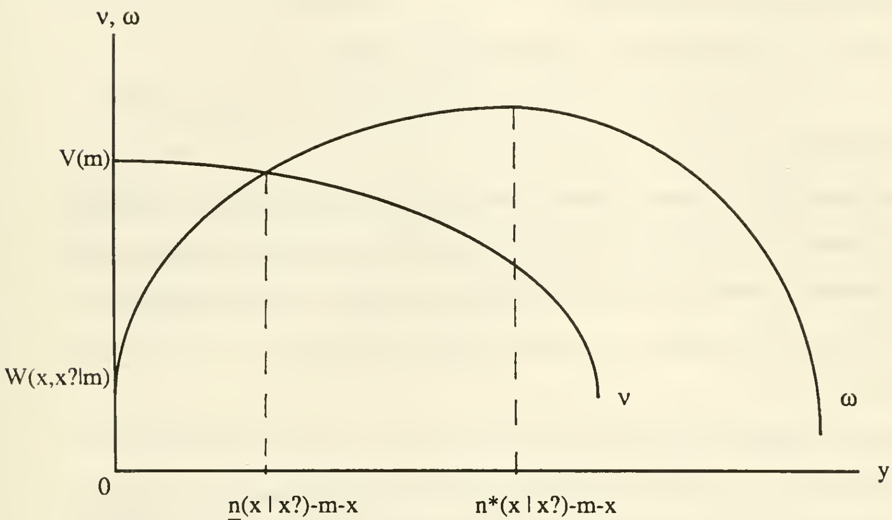
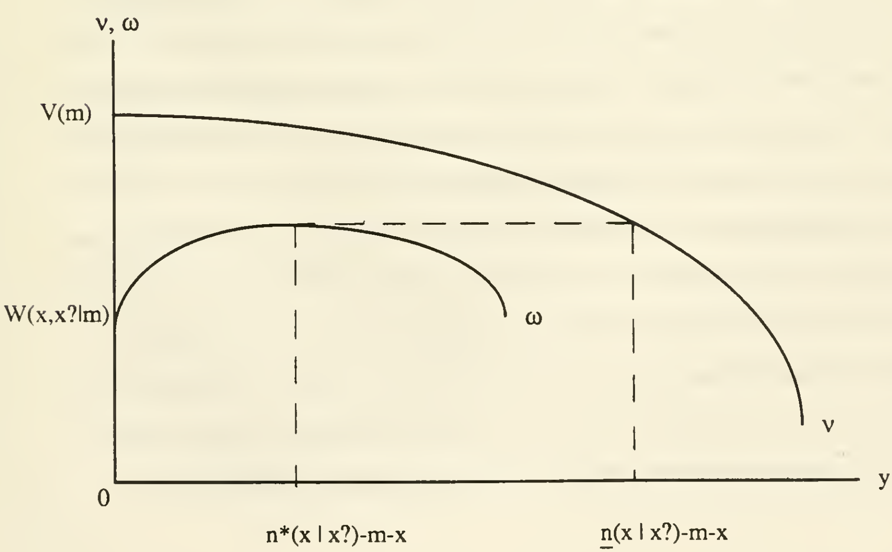


Figure 1(b)



where $\delta = 1$ iff $\underline{n}(x \mid x?) < n^*(x \mid x?)$ and $\delta = 0$ otherwise. Similarly, the first period expected value of the firm under management m is given by:

$$(10) \quad S(x \mid x?) = m + \delta\cdot[F(n^*(x \mid x?)) - F(\underline{n}(x \mid x?))]\cdot\int_{\underline{n}}^{n^*}[n-m]\cdot f(n)dn$$
$$+ \{\delta\cdot[1-F(n^*(x \mid x?))] + [1-\delta]\cdot[1-F(\underline{n}(x \mid x?))]\}\cdot[n^*(x \mid x?) - m]$$

and δ is defined as before.

The responsive defense y is chosen optimally by the management, independent of shareholder approval and given the bidder type that appears in the second period. Anticipatory defenses require shareholder approval and have to be set in the first period. Let x = x?. Then the manager's first period optimization problem is therefore to choose a request, $x? \geq 0$, to:

(11) max. $U(x \mid x?)$

subject to: $S(x \mid x?) \geq S(0 \mid x?)$.

Clearly, if the manager asks $x? = 0$, then the constraint trivially binds. However, if $x? > 0$ then the constraint says that the expected value of the firm conditional on the request being approved must be no less than its value if the request is rejected, given $x? > 0$. Because the incumbent manager's decision problem in the second period depends, *inter alia*, on his request, x?, in the first period -- whether or not this is granted -- we have in general that $S(0 \mid 0) \neq S(0 \mid x?)$ for any $x? > 0$. In other words, the relevant alternative that rational shareholders have to compare against the manager's request is not the situation prior to any request, $S(0 \mid 0)$, but the situation that would result if they reject the request, $S(0 \mid x?)$. This is the central idea of the model.[8]

If the constraint binds at some $x? > 0$, then shareholders are indifferent between accepting and rejecting the request. Since managers are not so indifferent, they can insure acceptance in such circumstances by slightly perturbing the request, x?, to induce strict preference on the part of shareholders: as Appendix A shows, such a perturbation is always available. So we assume that if the constraint binds, then the management request is approved. Alternatively, we can adopt the convention that in cases of shareholder indifference, shareholders always "vote with the management".

We turn now to some results.

3. Results

There are three possible conditions at the beginning of the second period: (1) the manager requested no anticipatory defenses, (2) the manager made a request which was voted down by shareholders, and (3) the manager's request was approved. Proposition 1 puts an ordering on the second period response to a takeover bid which maximizes the manager's outside value, conditional on the first-period outcome.

Proposition 1: Let $x = x? > 0$. Then $y^*(0 \mid 0) \geq y^*(0 \mid x?) > y^*(x \mid x?) > 0$.

Corollary 1: Let $x = x? > 0$. Then $x + y^*(x \mid x?) > y^*(0 \mid x?)$.

If a first-period request is rejected by shareholders, the second-period maximizing response is strictly larger than if the request is approved. However, from Corollary 1, total defenses (anticipatory plus responsive) are smaller if the request is rejected. Since total defenses determine the premium received in a successful bid, this implies that shareholders can expect a smaller premium if they reject the manager's request and a successful bidder emerges.

An interesting feature evident from Proposition 1 is that the second-period maximizing response is never larger after a request, even if the request is denied, than if no request is made. Thus, the request carries no implicit threat of "scorched earth" responses if shareholders deny it. Rather, as we show below, the request alters the manager's incentives to fight for a higher premium if a successful bidder appears.

Anticipatory and responsive defenses are substitutes in their effects on the minimum bid required to acquire the firm. Generally, the higher the level of anticipatory defense approved by shareholders in the first period, the lower will be the manager's choice of responsive defenses. Comparative statics on the maximizing second-period response (Appendix A, (a3) - (a7)) show that this response is non-increasing in the size of the first-period request. It is strictly decreasing in the first-period request, except when the manager's gross outside utility is additively separable in its two arguments <u>and</u> the first-period request is denied. In the special case of additive separability, it follows from Corollary 1 that total defenses, and therefore the premium from a successful bid, will be at least as large if requested anticipatory defenses are approved as if no anticipatory defenses were requested.

Value-maximizing shareholders consider both the size of the premium they can expect from a successful bid, and the probability that such a bid will emerge, in evaluating how to vote. Proposition 2 describes the probability of a successful takeover bid, as a function of requested anticipatory defenses and shareholder approval of the defenses.

Proposition 2:

(a) $\underline{n}(x \mid x?)$ is strictly increasing in x?, $x \in \{0, x?\}$;

(b) $\forall x = x? > 0$, $\underline{n}(x \mid x?) \geq \underline{n}(0 \mid x?) > \underline{n}(0 \mid 0)$.

Proposition 2 states that the minimum bid which can succeed against incumbent management increases with the amount of anticipatory defense requested. Since the probability that a successful bid will emerge falls as the minimum successful bid rises, part (a) of Proposition 2 implies that the probability of takeover declines with increases in the level of requested anticipatory defenses, whether or not these are approved. Part (b) implies that the probability of takeover is largest if no anticipatory defenses are requested, declines if there is a request, and may decline more if the request is approved. Notice that part (b) is not an immediate consequence of part (a): the change in state from $[x = x? \mid x? > 0]$ to $[x = 0 \mid x? > 0]$ is not incremental because of the "take it or leave it" nature of the shareholders' decision.

The value to shareholders from anticipatory takeover defense depends on both the premium if a successful bid is made, which generally increases with the level of anticipatory defense, and on the probability of a successful bid, which generally decreases. Proposition 3 shows that shareholders are unambiguously worse off if they reject management's request for anticipatory defenses than they were before the request.

Proposition 3: For $x? > 0$, $S(0 \mid 0) > S(0 \mid x?)$.

The voting (incentive compatibility) constraint in the model requires that approval of a request leave shareholders at least as well off as rejection. Proposition 3 states that shareholders are worse off if they reject the request than they would have been if no request had been made. (Note that this latter circumstance, no request, is not available to shareholders deciding how to vote on a request.) To complete our description of the apparent paradox that shareholders vote for defenses which leave them worse off, we require a comparison of shareholder value if the request is approved with shareholder value if no request is made. Proposition 4 gives a sufficient condition for the apparent paradox to occur.

Proposition 4: $V(m) < W(y^*(0 \mid 0), 0 \mid m)$

$$\Rightarrow \exists x? \in (0, \infty): S(0 \mid 0) > S(x \mid x?) \geq S(0 \mid x?),\ x = x?.$$

According to Proposition 4, if the manager's utility from employment with the firm is less than his maximum gross outside utility before any request for anticipatory defenses, then requests exist which shareholders will approve, but which leave them worse off than they were before. Recall that we assumed the manager's utility from employment in the firm was larger than his initial gross outside utility. The sufficient condition in Proposition 4 describes a manager whose optimal response to a sufficiently high bid is to fight for a higher premium, and then to leave for higher-valued outside opportunities.

With Proposition 4, we have shown the existence of requested levels of anticipatory defense which result in the voting behavior we hoped to describe. That is, rational, informed, value-maximizing shareholders will approve the defenses, but are made worse off by them. The sufficient condition for the result depends on the manager's utility in current and alternative employment. We have not yet demonstrated, however, that these levels of anticipatory defense would in fact be requested by managers with utilities satisfying the sufficient condition. There is no inconsistency between utilities satisfying this condition and utilities generating the level of anticipatory defense, identified in the Proposition, as a best choice. In Appendix B, we provide an example of a manager with utility satisfying the condition of Propostion 4, whose best choice of anticipatory defense will be approved by shareholders, and will leave them worse off than if no request had been made. The example is in no sense pathological.

It is worth noting that under some circumstances, shareholders can be made better off by implementing some anticipatory defense. By Proposition 3, a necessary condition for this to occur is that the manager's request, x?, be strictly interior to the constraint set; i.e. $S(x \mid x?) > S(0 \mid x?)$. This amounts to the manager's unconstrained best level of anticipatory defense being strictly less than shareholders' most-preferred level.[9]

The primary implication of our model for interpreting the empirical work which has preceded it is that inferences about whether shareholders vote rationally cannot be made from a comparison of shareholder wealth before and after the vote. We describe the alternative to voting with management as an unambiguous drop in shareholder value, not as a return to the pre-proposal *status quo*. Therefore, pre-proposal shareholder wealth is not the correct benchmark for determining shareholder rationality. Our model suggests that empirical investigation of shareholder voting and takeover defenses should consider the manager's outside employment opportunities, and the manager's skill relative to potential bidders.

4. Conclusion

We have provided a rational choice model of shareholder voting on anticipatory takeover defenses. In our model, it is feasible for informed, value-maximizing shareholders to approve measures which leave them worse off than they were before the measures were requested. What drives this result is that a manager, in requesting such measures, lowers his outside market value. Consequently, the manager's optimal response to an actual takeover bid is different if the request is rejected than if he had made no request. Shareholders recognize this in evaluating how to vote.

In the model, the manager's type and utility schedule are common knowledge. This raises the question of why any manager would be hired who will wish to implement anticipatory defenses which decrease the value of the firm to shareholders. To this extent, our model is incomplete. We have in mind a signalling game which precedes the two periods we study. At this earlier stage, perhaps the hiring stage, the manager's type is not known with certainty. The request x? functions as a signal, and we are implicitly assuming the signal fully reveals the manager's type (and utility). In other words, our model is predicated on the existence of a separating equilibrium to this earlier signalling game.

Finally, we offer two remarks. First, it is frequently asserted (cf. Easterbrook and Fischel (1983)) that the alienability of ownership claims protects shareholders from detrimental management entrenchment tactics. However, unless shareholders anticipate the proposal of takeover defenses by management, they cannot alienate their voting claim in response to the proposal. SEC proxy mailing requirements demand that the record date for shareholder voting precede the proposal date. Once the proposal is announced, the constituency is fixed. Our model suggests that any drop in share value should occur with the announcement of the proposal, not with the vote.

Second, our model implies that changes in shareholder wealth associated with voting on takeover defenses may be positive or negative, depending on the manager's type and utility schedule. In cases where shareholders' wealth is reduced, the reduction should occur at the date of the manager's request. If there is any detectable change at the date of the vote, it should be positive. This follows from Proposition 3 and the voting constraint: the first states that shareholders' wealth is unambiguously reduced if they reject a request; the second ensures that shareholders' wealth under rejection is no larger than their wealth under approval. On this interpretation, empirical results which find shareholders' wealth declines following implementation of anticipatory defenses are not evidence of shareholder irrationality or ignorance.

Appendix A: Proofs

Proposition 1: Let $x = x? > 0$. Then: $y^*(0 \mid 0) \geq y^*(0 \mid x?) > y^*(x \mid x?) > 0$.

Proof: As remarked in section 2, the last inequality follows from assuming $W_1 > 0$ everywhere, and $\lim._{y \to \infty} c'(y) = 0$. To check $y^*(0 \mid 0) \geq y^*(0 \mid x?)$, use (3) to obtain:

(a.1) $W_1(y^*(0 \mid 0), 0 \mid \cdot) - W_1(y^*(0 \mid x?), x? \mid \cdot) = c'(y^*(0 \mid 0)) - c'(y^*(0 \mid x?))$.

Suppose $y^*(0 \mid 0) < y^*(0 \mid x?)$. Then:

$W_1(y^*(0 \mid 0), 0 \mid \cdot) - W_1(y^*(0 \mid x?), x? \mid \cdot) > 0$, by $W_{11} < 0$, $W_{12} \leq 0$ and $x? > 0$.

But $c'' \geq 0$ implies the RHS(a.1) ≤ 0: contradiction. To check $y^*(0 \mid x?) > y^*(x \mid x?)$, again use the first order condition (3) to get:

(a.2) $W_1(x + y^*(x \mid x?), x? \mid \cdot) - W_1(y^*(0 \mid x?), x? \mid \cdot) = c'(y^*(x \mid x?)) - c'(y^*(0 \mid x?))$.

Suppose $y^*(0 \mid x?) \leq y^*(x \mid x?)$. Then $c'' \geq 0$ implies RHS(a.2) ≥ 0. But $x = x? > 0$, so that $W_{11} < 0$ implies LHS(a.2) < 0: contradiction. ||

Remark 1: $y^*(0 \mid 0) = y^*(0 \mid x?)$ iff $W_{12} \equiv 0$. Hence, $x = x? > 0$ and $W_{12} \equiv 0$ imply:

$[x + y^*(x \mid x?)] > y^*(0 \mid 0)$.

Corollary 1: Let $x = x? > 0$. Then $[x + y^*(x \mid x?)] > y^*(0 \mid x?)$.

Proof: Use (3) and Proposition 1 with $W_{11} < 0$. ||

Before proceeding to establish the remaining Propositions, it is convenient to report the following comparative statics.

(a.3) $x = x? \Rightarrow dy^*(x \mid x?)/dx? = -[W_{11}+W_{12}]/[W_{11}-c''] < 0$.

(a.4) $dy^*(0 \mid x?)/dx? = -W_{12}/[W_{11}-c''] \leq 0$, with the inequality strict iff $W_{12} < 0$.

(a.5) $x = x? \Rightarrow d\omega(x, y \mid x?)/dx? = W_1 + W_2$, which a priori has ambiguous sign.

(a.6) $d\omega(0, y \mid x?)/dx? = W_2 < 0$.

Note that at any y, | (a.5) | < | (a.6) |. By definition, $n^*(x \mid x?) = x + y^*(x \mid x?) + m$. And since $y^*(x \mid x?)$ is differentiable in x?, $n^*(x \mid x?)$ is differentiable in x?. If x = 0, then $\partial n^*(0 \mid x?)/\partial x?$ is given by (a.4). If x = x?, then $\partial n^*(x \mid x?)/\partial x? = 1 + dy^*(x|x?)/\partial x?$. Substituting from (a.3) and collecting terms, we obtain:

(a.7) $\partial n^*(x \mid x?)/\partial x \geq (<) \ 0$ as $c''(y^*(x \mid x?)) \geq (<) -W_{12}(x+y^*(x \mid x?), x? \mid\cdot)$.

Lemma 1: Let x? ≥ 0, x ∈ {0, x?}. Then, $\underline{n}(x \mid x?)$ is differentiable in x?; and $\partial \underline{n}(x \mid x?)/\partial x? > 0$.

Proof: Let x = x? ≥ 0. Consider the difference, $\Delta^* = [v(n^*(x \mid x?), x \mid\cdot) - \omega(x, y^*(x \mid x?) \mid x?)]$. Differentiating this with respect to x? (at x? = x), and using the first-order condition (3) gives,

$\partial \Delta^*/\partial x? = -W_2(x+y^*(x|x?), x? \mid\cdot) > 0$.

Therefore, Δ* can change sign at most once as x increases, and this change can only be from negative to positive. Suppose there exists an $\underline{x} = \underline{x}?$ such that Δ* = 0. Then this value is unique and we have, $V(m) \leq (>) W(x+y^*(x \mid x?), x? \mid\cdot)$ iff $x \leq (>) \underline{x}$. So by definition (6), $\underline{n}(x \mid x?) \leq (>) n^*(x \mid x?)$ iff $x \leq (>) \underline{x}$. Consider $x < \underline{x}$. By (6), $\underline{n}(x \mid x?)$ is implicitly defined by,

$V(m) - W(\underline{n}(x \mid x?)-m, x? \mid\cdot) = 0$.

In this case, $\underline{n}(x \mid x?)$ is differentiable because W is differentiable. In particular, $\forall x < \underline{x}$,

(a.8) $\partial \underline{n}(x \mid x?)/\partial x? = -W_2(\underline{n}(x|x?)-m, x? \mid\cdot)/W_1(\underline{n}(x|x?)-m, x? \mid\cdot)$;

and,

(a.9) $\lim_{x \to \underline{x}^-} [\partial \underline{n}(\cdot\mid\cdot)/\partial x?] = -W_2(n^*(\underline{x} \mid \underline{x}?)-m, \underline{x}? \mid\cdot)/W_1(n^*(\underline{x} \mid \underline{x}?)-m, \underline{x}? \mid\cdot)$.

Now consider $x > \underline{x}$. By (6), $\underline{n}(x \mid x?)$ is implicitly defined by,

$V(m) - c(\underline{n}(x \mid x?)-x-m) - \omega(x, y^*(x \mid x?) \mid x?) = 0$.

Again, differentiability of $\underline{n}(x \mid x?)$ follows from differentiability of c and W. In particular, using (3), we have that $\forall x > \underline{x}$,

(a.10) $\partial \underline{n}(x \mid x?)/\partial x? = [c'(\underline{n}(x|x?)-x-m) - W_1^*(x) - W_2^*(x)]/c'(\underline{n}(x|x?)-x-m)$, where $W_i^*(x) \equiv W_i(n^*(x|x?)\text{-}m, x?\ |\cdot)$, i =1, 2. Hence,

(a.11) $\lim_{x\to \underline{x}+} [\partial\underline{n}(\cdot|\cdot)/\partial x?] = [c'(n^*(\underline{x}|\underline{x}?)\text{-}\underline{x}\text{-}m) - W_1^*(\underline{x}) - W_2^*(\underline{x})]/c'(n^*(\underline{x}|\underline{x}?)\text{-}\underline{x}\text{-}m)$

$= -W_2(n^*(\underline{x}|\underline{x}?)\text{-}m, \underline{x}?\ |\cdot)/W_1(n^*(\underline{x}|\underline{x}?)\text{-}m, \underline{x}?\ |\cdot)$;

the second equality following from another application of (3). Together, (a.9) and (a.11) complete the argument for $\underline{n}(x \mid x?)$ being differentiable everywhere when x = x? (recall that from section 2, $\underline{n}(x \mid x?) > x+m$, $\forall x, x? \geq 0$). That $\partial\underline{n}(x \mid x?)/\partial x? > 0$ for all $x = x? \leq \underline{x}$ is immediate from (a.8) and (a.9). Let $x > \underline{x}$, and consider (a.10). By (3), $W_1^*(x) = c'(y^*(x|x?)) = c'(n^*(x|x?)\text{-}x\text{-}m)$. Since $\Delta^* > 0$, $n^*(x|x?) < \underline{n}(x|x?)$. Therefore, $c'' \geq 0$ all y, implies,

(a.12) $c'(\underline{n}(x \mid x?)\text{-}x\text{-}m) \geq W_1^*(x) > 0$.

Moreover, $W_1+W_2 < W_1$. Therefore, the numerator of (a.10) is strictly positive. Since $c' > 0$, this completes the proof of the Lemma for x = x?. Now suppose x = 0 and x? > 0. Similar reasoning as before gives $\underline{n}(0 \mid x?)$ differentiable in x?, and $\partial\underline{n}(0 \mid x?)/\partial x? > 0$ follows on implicit differentiation of (6) for the two cases. ||

Remark 2: (a.7) and Lemma 1 imply that U(x | x?) and S(x | x?) are differentiable in x?.

Lemma 2: Let x = x? > 0. Then, $\underline{n}(x \mid x?) \geq \underline{n}(0 \mid x?)$;

Proof: (α) $V(m) < W(x+y^*(x \mid x?), x?\ |\cdot) \Rightarrow V(m) = W(\underline{n}(x \mid x?) - m, x?\ |\cdot)$ by (6). There are two possibilities:

(α.1) $V(m) \leq W(n^*(0 \mid x?) - m, x?\ |\cdot) \Rightarrow V(m) = W(\underline{n}(0 \mid x?) - m, x?\ |\cdot)$, by (6)

$\Rightarrow W(\underline{n}(x \mid x?) - m, x?\ |\cdot) = W(\underline{n}(0 \mid x?) - m, x?\ |\cdot)$

$\Rightarrow \underline{n}(x \mid x?) = \underline{n}(0 \mid x?)$.

(α.2) $V(m) > W(n^*(0 \mid x?) - m, x?\ |\cdot) \Rightarrow V(m) = [\omega(0, y^*(0 \mid x?) \mid x?) + c(\underline{n}(0 \mid x?) - m)]$, by (6)

$\Rightarrow W(\underline{n}(x \mid x?) - m, x?\ |\cdot) - c(\underline{n}(0 \mid x?) - m) = \omega(0, y^*(0 \mid x?) \mid x?)$.

By definition of $y^*(0 \mid x?)$,

$\omega(0, y^*(0 \mid x?) \mid x?) > W(\underline{n}(0 \mid x?) - m, x? \mid\cdot) - c(\underline{n}(0 \mid x?) - m)$.

Therefore,

$W(\underline{n}(x \mid x?) - m, x? \mid\cdot) - c(\underline{n}(0 \mid x?) - m) > W(\underline{n}(0 \mid x?) - m, x? \mid\cdot) - c(\underline{n}(0 \mid x?) - m)$

$\Rightarrow \underline{n}(x \mid x?) > \underline{n}(0 \mid x?)$.

This proves the proposition for case (α).

(β) $V(m) \geq W(x+y^*(x \mid x?), x? \mid\cdot) \Rightarrow V(m) = \omega(x, y^*(x \mid x?) \mid x?) + c(\underline{n}(x \mid x?)-x-m)$, by (6). By Corollary 1 and $x? > 0$, $W(x+y^*(x \mid x?), x? \mid\cdot) > W(y^*(0 \mid x?), x? \mid\cdot)$. Hence, $V(m) > W(n^*(0|x?)-m, x? \mid\cdot)$. So by (6),

(a.13) $V(m) = \omega(0, y^*(0 \mid x?) \mid x?) + c(\underline{n}(0 \mid x?) - m)$.

Therefore,

(a.14) $\omega(x, y^*(x \mid x?) \mid x?) - \omega(0, y^*(0 \mid x?) \mid x?) = c(\underline{n}(0 \mid x?)- m) - c(\underline{n}(x \mid x?)-x-m)$.

By Proposition 1 and Corollary 1, LHS(a.14) is strictly positive; hence, the RHS(a.14) must likewise be strictly positive. Since $c' > 0$ and $x = x? > 0$, this implies,

(a.15) $\underline{n}(0 \mid x?) > \underline{n}(x \mid x?) - x$.

Now implicitly differentiating (a.13), we obtain $\forall x? \geq 0$:

$\partial\underline{n}(0 \mid x?)/\partial x? = -W_2(y^*(0|x?), x? \mid\cdot)/c'(\underline{n}(0|x?)-m) > 0$.

Using (a.10), we have $\forall x? \geq 0$:

(a.16) $[\partial\underline{n}(x \mid x?)/\partial x? - \partial\underline{n}(0 \mid x?)/\partial x?] = \{1 - [W_1(x+y^*(x|x?), x? \mid\cdot)/c'(\underline{n}(x|x?)-x-m)]\}$

$+ \{[W_2(y^*(0|x?), x?|\cdot)/c'(\underline{n}(0|x?)-m)] - [W_2(x+y^*(x|x?), x? \mid\cdot)/c'(\underline{n}(x|x?)-x-m)]\}$.

By (a.12), the first term of (a.16) in $\{\cdot\}$ is nonnegative $\forall x? > 0$, and, because $\lim_{y\to 0} c'(y) = 0$, this term is strictly positive for y in the neighborhood of zero . Consider the second term in $\{\cdot\}$. By Corollary 1, $W_2 < 0$, and $W_{12} \leq 0$,

(a.17) $0 > W_2(y^*(0 \mid x?), \cdot|\cdot) \geq W_2(x+y^*(x \mid x?), \cdot|\cdot)$.

By (a.15) and $c'' \geq 0$,

(a.18) $0 < c'(\underline{n}(x \mid x?)-x-m) \leq c'(\underline{n}(0 \mid x?)-m)$.

Together, (a.17) and (a.18) imply that the second term of (a.16) in $\{\cdot\}$ is also nonnegative $\forall$x? > 0 and, as with the first term of (a.16), strictly positive for y in the neighborhood of zero. When x? = 0, both terms in $\{\cdot\}$ vanish. Therefore, $\forall$x? ≥ 0:

$$[\underline{n}(x \mid x?) - \underline{n}(0 \mid x?)] = \int_0^{x?}[\partial\underline{n}(r \mid r)/\partial r - \partial\underline{n}(0 \mid r)/\partial r]dr \geq 0,$$

as required (with equality iff x? = 0). ||

Remark 3: Notice that Lemma 2 is <u>not</u> implied by Lemma 1: this is because the change in state from [x=x? | x? > 0] to [x=0 | x? > 0] is not incremental.

Remark 4: Together, Remark 2 and Lemma 2 justify the claim made in section 2 that, if x = x? and S(x | x?) = S(0 | x?), then there exists a perturbation in x? -- say, x?~ -- such that S(x~ | x?~) > S(0 | x?~).

Lemma 3: For any x? > 0, $\underline{n}$(0 | x?) > $\underline{n}$(0 | 0).

Proof: Given x = 0, v(n, x | m) = V(m) - c(n-m). Since c' > 0, v(n, x | m) is strictly decreasing in n. By $W_2 < 0$, W(y, x? |·) < W(y, 0 |·), all y ≥ 0. So, by (6), $\underline{n}$(0 | x?) > $\underline{n}$(0 | 0), $\forall$x? > 0. ||

Combining Lemmas 1, 2 and 3, we have proved:

Proposition 2: (a) $\underline{n}$(x | x?) is strictly increasing in x?, x ∈ {0, x?}; and,

(b) $\forall$x = x? > 0, $\underline{n}$(x | x?) ≥ $\underline{n}$(0 | x?) > $\underline{n}$(0 | 0).

Proposition 3: For x? > 0, S(0 | 0) > S(0 | x?).

Proof: By Lemma 3, $\underline{n}$(0 | x?) > $\underline{n}$(0 | 0). Hence the probability of a successful takeover bid being made given x? > 0 is strictly less than when x? = 0:

(a.19) $[1\text{-}F(\underline{n}(0 \mid x?))] < [1\text{-}F(\underline{n}(0 \mid 0))]$.

By Proposition 1, $n^*(0 \mid x?) \le n^*(0 \mid 0)$, with the inequality strict iff $W_{12} < 0$ at any $y \le y^*(0 \mid 0)$. Therefore, by (8), $\forall n \ge \underline{n}(0 \mid x?)$,

(a.20) $\pi(n, 0 \mid 0) \ge \pi(n, 0 \mid x?)$.

And if $n^*(0 \mid x?) < n^*(0 \mid 0)$, then the inequality in (a.20) is strict $\forall n > n^*(0 \mid x?)$. By an argument in section 2, only types $n > \underline{n}(\cdot|\cdot)$ will make takeover bids. Therefore, $\forall n \in (\underline{n}(0 \mid 0), \underline{n}(0 \mid x?))$,

(a.21) $\pi(n, 0 \mid 0) > \pi(n, 0 \mid x?) \equiv 0$.

Likewise, $\forall n \le \underline{n}(0 \mid 0)$,

(a.22) $\pi(n, 0 \mid 0) = \pi(n, 0 \mid x?) \equiv 0$.

Together, (10) and (a.19) - (a.22) yieldthe desired result. ||

Lemma 4: Let $x = x?$. Then, $\lim._{x? \to \infty} S(x \mid x?) = m$.

Proof: By assumption, $W_{11} < 0$ and $\lim._{x? \to \infty} W_2 = -\infty$. Therefore, for sufficiently large x?, say x? > x?', we have $V(m) > W(x+y^*(x \mid x?), x? \mid \cdot)$. Hence, by (10), $\forall x? \ge x?'$,

$S(x \mid x?) = m + [1\text{-}F(\underline{n}(x \mid x?))]\cdot[n^*(x \mid x?)\text{-}m]$.

By Remark 2, $S(\cdot \mid \cdot)$ is differentiable in x?. In particular, $\forall x? \ge x?'$,

(a.23) $\partial S(x \mid x?)/\partial x? =$

$$[1\text{-}F(\underline{n}(x \mid x?))]\cdot\partial n^*(x \mid x?)/\partial x? - \{f(\underline{n}(x \mid x?))\cdot\partial\underline{n}(x \mid x?)/\partial x?\cdot[n^*(x \mid x?)\text{-}m]\}.$$

We prove the Lemma by showing $\partial S(x \mid x?)/\partial x? < 0$ for all finite x? ≥ x?" ≥ x?', x?" sufficiently large. By Lemma 1 and the assumption that $V(m) > W(0, 0 \mid m)$, the term in $\{\cdot\}$ on the RHS(a.23) is strictly positive for all finite x?. By (a.7), the first term on the RHS(a.23) is of ambiguous sign. Suppose $\partial n^*(\cdot|\cdot)/\partial x? \le 0$ for all x? ≥ x?'. Then, $\partial S(x \mid x?)/\partial x? < 0$ for all finite x? ≥ x?'. Now suppose $\partial n^*(x \mid x?)/\partial x? > 0$ for all x? sufficiently large. By (7) and (a.3), $\sup.[\partial n^*(x \mid x?)/\partial x?] = 1$. Therefore, for sufficiently large x?, $\partial S(x \mid x?)/\partial x? < 0$ if:

(a.24) $[1\text{-}F(\underline{n}(x \mid x?))]/f(\underline{n}(x \mid x?)) < \partial\underline{n}(x \mid x?)/\partial x?\cdot[n^*(x \mid x?) - m]$.

By assumption, $\lim_{t\to\infty} [[1-F(t)]/f(t)] < \infty$. Therefore, by Lemma 1 and x = x?, $\lim_{x?\to\infty}$[LHS(a.24)] < ∞. Again by assumption, $W_{11} < 0$ and $\lim_{x?\to\infty} W_2 = -\infty$: from (a.10), therefore, $\partial \underline{n}(x \mid x?)/\partial x? > 1$ for sufficiently large x?. By hypothesis, $\partial n^*(x \mid x?)/\partial x? > 0$, ∀x? ≥ x?'. Hence, (7), y ≥ 0, and x = x?, together imply that $\lim_{x?\to\infty}$[RHS(a.24)] = ∞. Therefore, there exists a sufficiently large value of x? -- x?" ≥ x?' -- such that $\partial S(x \mid x?)/\partial x? < 0$ for all x? ≥ x?". Since $\lim_{t\to\infty} [1-F(t)] = 0$, the Lemma follows from (10). ||

Proposition 4: V(m) < W(y*(0 | 0), 0 | m)

$$\Rightarrow \exists x? \in (0, \infty) : S(0 \mid 0) > S(x \mid x?) \geq S(0 \mid x?),\ x = x?.$$

Proof: By Remark 2, ∃x?* > 0 such that both V(m) < W(x*+y*(x* | x?*), x?* |·), and V(m) ≤ W(y*(0 | x?*), x?* |·) obtain (x* = x?*). Then by case (α.1) of Lemma 2, $\underline{n}$(x* | x?*) = $\underline{n}$(0 | x?*) = $\underline{n}$. Hence the likelihood of takeover is the same whether or not the request x?* is accepted:

(a.25) $[1-F(\underline{n}(x^* \mid x?^*))] = [1-F(\underline{n}(0 \mid x?^*))] = [1-F(\underline{n})]$.

Also, n*(x* | x?*) > n*(0 | x?*) > $\underline{n}$: the first inequality follows from Corollary 1, and the second from the premise of the Proposition and the choice of x?*. By an argument of section 2, only types n > $\underline{n}$ will make any takeover bid: hence, π(n, x* | x?*) = π(n, 0 | x?*) ≡ 0, ∀n ≤ $\underline{n}$. By (8),

(a.26) ∀n ∈ ($\underline{n}$, n*(0 | x?*)], π(n, x* | x?*) = π(n, 0 | x?*) = n - m;

∀n > n*(0 | x?*), π(n, x* | x?*) > π(n, 0 | x?*).

Given (10), (a.25) and (a.26) imply that S(x* | x?*) > S(0 | x?*). Therefore,

$$C = \{x? > 0 \mid S(x \mid x?) \geq S(0 \mid x?),\ x = x?\} \neq \varnothing.$$

Let x = x?. There are now two cases:

(i) [∃x? ∈ C : x? < ∞ & S(x | x?) = S(0 | x?)] ⇒ [S(0 | 0) > S(x | x?)], by Proposition 3;

(ii) [∀x? ∈ C : x? < ∞ , S(x | x?) > S(0 | x?)] ⇒ [∃x?'∈ C : x?' < ∞ & S(0 | 0) > S(x' | x?')], by Lemma 4 and S(0 | 0) > m. To check this last inequality, recall V(m) < W(y*(0 | 0), 0 |·) by hypothesis. Hence, by (6) and y*(0 | 0) > 0 (Proposition 1), m < $\underline{n}$(0 | 0) < ∞ and n*(0 | 0) > m. ||

Appendix B: Example

We claim in section 3 of the text that Proposition 4 allows us to infer the existence of managerial utilities under which the manager would ask for, and shareholders approve, a level of anticipatory defense, x?, such that $S(0 \mid 0) > S(x \mid x?)$. In this appendix, we justify our claim with an example.

In the interests of computational simplicity, two assumptions of the model are violated in the example: *viz.* the support of F is not the whole real line, and $\lim_{y \to 0} c'(y) \neq 0$. We argued that both of these assumptions are technical conveniences, and the example here supports our case. Also, there are choices of the distribution function F and the cost function c(y) that do satisfy all the assumptions of the text, and which are arbitrarily closely approximated by the functional forms exploited in the example.

Let F be uniform on the closed interval [p, q]. We write $L = q - p$, and assume $L \geq 4$. Assume the manager's type is $m = [p+q]/2 = 0$; and let,

$V(m) = 3/2,$

$W(x+y, x? \mid m) = 2 \cdot [x+y]^{1/2} - [x?^2]/2 + m,$

$c(y) = y.$

Then, $\partial\omega/\partial y \mid_{x?} = [x+y]^{-1/2} - 1$; whence,

(b.1) $y^*(x \mid x?) = 1 - x, \forall x \in [0, 1]$

$= 0, \forall x > 1.$

As we demonstrate later, the manager's unconstrained (and constrained) utility-maximizing value of x? is 1. Without loss of generality, then, we assume $x \in [0, 1]$.

Therefore, $\forall x \in [0, 1]$,

(b.2) $n^*(x \mid x?) = 1,$

(b.3) $\partial n^*(x \mid x?)/\partial x? = 0.$

When $V(\cdot) < W(x+y^*(x|x? |\cdot)$, $\underline{n}(x \mid x?)$ is given by (cf. (6)), $V(\cdot) - W(\underline{n}(x \mid x?)-m, x? |\cdot) = 0$.

Hence, given $V(\cdot) < W(x+y^*(x \mid x?), x? |\cdot)$,

(b.4) $\underline{n}(x \mid x?) = [3 + (x?)^2]^2/16$,

(b.5) $\partial\underline{n}(x \mid x?)/\partial x? = [3 + (x?)^2]\cdot x?/4$.

Suppose $x? = x = 0$. Then, $y^*(0 \mid 0) = 1$ and so, $V(\cdot) = 3/2 < W(y^*(0 \mid 0), 0 |\cdot) = 2$. Hence,

(b.6) $\omega(0, n^*(0 \mid 0) \mid 0) = 2 - 1 = 1$,

(b.7) $\underline{n}(0 \mid 0) = 9/16$ and $\partial\underline{n}(0 \mid 0)/\partial x? = 0$,

(b.8) $\omega(0, \underline{n}(0 \mid 0) \mid 0) = 2\cdot\sqrt{(9/16)} - (9/16) = 15/16$.

We also have, $\partial\omega(x, y \mid x?)/\partial x? = [x+y]^{-1/2} - x?$. So, at $x? = x = 0$:

(b.9) $\partial\omega(0, n^*(0 \mid 0)-m \mid 0)/\partial x? = 1$,

(b.10) $\partial\omega(0, \underline{n}(0 \mid 0)-m \mid 0)/\partial x? = 4/3$.

Hence, at $x? = x = 0$:

(b.11) $\int\partial\omega/\partial x?\cdot f(n)dn = [1 - 4/3]/L = -1/3L$,

and,

(b.12) $\int\omega\cdot f(n)dn = [1 - 15/16]/L = 1/16L$.

From (9), taking $\delta = 1$:

(b.13) $$[\partial U/\partial x?]|_{x=x?} = f(\underline{n})\cdot\partial\underline{n}/\partial x?\cdot V(\cdot)$$
$$+ [F(n^*)-F(\underline{n})]\cdot[\int\partial\omega/\partial x?\cdot f(n)dn + \omega^*\cdot\partial n^*/\partial x? - \underline{\omega}\cdot\partial\underline{n}/\partial x?]$$
$$+ [f(n^*)\cdot\partial n^*/\partial x? - f(\underline{n})\cdot\partial\underline{n}/\partial x?]\cdot\int\omega\cdot f(n)dn$$
$$+ [1-F(n^*)]\cdot\partial\omega^*/\partial x? - f(n^*)\cdot\partial n^*/\partial x?\cdot\omega^*.$$

Here, $\omega^* \equiv \omega(x, n^*-m \mid x?)$ and $\underline{\omega} \equiv \omega(x, \underline{n}-m \mid x?)$. Substituting from (b.1) - (b.12) gives,

$$[\partial U/\partial x?]|_{x=x?=0} = -[(1-p)/L - (9/16 - p)/L]/3L + [1 - (1-p)/L]$$
$$= [q - 1 - 7/48L]/L.$$

Given $\delta = 1$, $\partial U/\partial x? > 0$ at $x = x? = 0$ iff $[q - 1 - 7/48L] > 0$. By construction, $L = 2q > 0$.

Hence,

$[\partial U/\partial x?]|_{x=x?=0} > 0 \Leftrightarrow q^2 - q - 7/96 > 0$

$\Leftrightarrow q > 1.07.$

Therefore, because $L \geq 4$ by assumption, the manager's utility is increasing in x at zero if $\delta = 1$. But when $x? = x = 0$, $V(\cdot) < W(y^*(0 \mid 0), 0 \mid \cdot)$: hence $\delta = 1$.

Similarly, from (10), taking $\delta = 1$:

(b.14) $[\partial S/\partial x?]|_{x=x?} = [f(n^*)\cdot\partial n^*/\partial x? - f(\underline{n})\cdot\partial \underline{n}/\partial x?]\cdot\int[n-m]\cdot f(n)dn$

$+ [F(n^*)-F(\underline{n})]\cdot[F(n^*)-F(\underline{n})+[n^*-m]\cdot\partial n^*/\partial x? - [\underline{n}-m]\cdot\partial \underline{n}/\partial x?]$

$+ [1-F(n^*)]\cdot\partial n^*/\partial x? - f(n^*)\cdot\partial n^*/\partial x?\cdot[n^*-m].$

Substituting where appropriate from (b.1) - (b.12) at $x = x? = 0$, gives:

$[\partial S/\partial x?]|_{x=x?=0} = [7/16L]^2 > 0.$

So shareholders too would prefer some anticipatory takeover defense, relative to having none.

Consider $x? = x = 1$. Then from (b.1), $y^*(1 \mid 1) = 0$. Hence,

(b.15) $V(\cdot) = 3/2 = W(1+y^*(1 \mid 1), 1 \mid \cdot)$,

(b.16) $n^*(1 \mid 1) = \underline{n}(1 \mid 1) = \underline{n}(0 \mid 1) = 1$, from (b.2) and (b.4),

(b.17) $\partial \underline{n}(1 \mid 1)/\partial x? = 1$, from (b.5),

(b.18) $[V(\cdot) - \omega(1, y^*(1 \mid 1) \mid 1)] = c(y^*(1 \mid 1)) = 0$.

Given (b.15), $[\partial U(1 \mid 1)/\partial x?]|_{\delta=1} = [\partial U(1 \mid 1)/\partial x?]|_{\delta=0}$. Hence, from (9),

$\partial U(1 \mid 1)/\partial x? = f(\underline{n})\cdot\partial \underline{n}/\partial x?\cdot[V(\cdot) - \omega^*] + [1-F(\underline{n})]\cdot\partial\omega^*/\partial x?$

$= [1-F(\underline{n})]\cdot\partial\omega^*/\partial x?$, by (b.18).

Substituting for $\partial\omega^*/\partial x?$ gives,

$\partial U(1 \mid 1)/\partial x? = 0.$

Furthermore, by (b.17), (b.18), and F uniform,

$\partial^2 U(1 \mid 1)/\partial x?^2 = [1-F(\underline{n})]\cdot\partial^2\omega^*/\partial x?^2 - f(\underline{n})\cdot\partial\omega^*/\partial x?$

$= -3\cdot[q-1]/2L < 0.$

Therefore, $x = x? = 1$ is an unconstrained maximum for the manager (indeed, it is a global maximum).

Proceeding similarly, we obtain from (10),

$\partial S(1 \mid 1)/\partial x? = [1-F(\underline{n})]\cdot\partial n^*/\partial x? - f(\underline{n})\cdot\partial \underline{n}/\partial x?\cdot[n^*-m]$.

Substituting,

$\partial S(1 \mid 1)/\partial x? = -1/L < 0$.

Therefore, the shareholders' most preferred value for x is strictly less than the manager's.

To check that the manager's unconstrained optimum, x = 1, is in the constraint set, we use (10) and substitute from above to find:

$$S(1 \mid 1) = [1 - (1-p)/L]$$
$$= [q-1]/2q$$
$$= S(0 \mid 1).$$

Therefore, x? = 1 will be approved by the shareholders if it is requested by the manager -- as it surely will be. By Proposition 3, $S(0 \mid 0) > S(1 \mid 1)$: in particular,

$$S(0 \mid 0) = [(1-p)/L - (9/16 - p)/L]\cdot[1 - 9/16]/L + [1 - (1-p)/L]$$
$$= [7/32q]^2 + [q-1]/2q$$
$$> S(1 \mid 1). \parallel$$

Footnotes.

1. DeAngelo and Rice (1983) provide a thorough discussion of these hypotheses.

2. The use of the term "type" differs somewhat from the usual game-theoretic concept: here, "type" indicates a skill level, so that managers of the same "type" can have different utilities. Further, allowing infinite m is only a technical convenience; a claim we justify via the worked example of Appendix B.

3. For example, the uniform, normal, gamma and exponential distributions all satisfy this restriction.

4. This structure is similar to that used in Grossman and Hart (1980).

5. This type of "take it or leave it" agenda control has been extensively studied in a political context by Romer and Rosenthal (1978, 1979).

6. The role of the assumption that $\lim._{y\to 0} c'(y) = 0$, is to insure that some strictly positive level of y will always be chosen by the manager, whatever the value of x. Consequently, we can use the calculus in our analysis. Without the assumption, we have to consider the corner case explicitly: this adds very little and does not substantively alter our main results. Again, this assertion is vindicated by the example in Appendix B, in which -- for computational ease -- $c'(y) = 1$ for every $y \geq 0$.

7. Notice that, because $\lim._{y\to 0} c'(y) = 0$ by assumption, we must have $c''(y) > 0$ at least in the neighborhood of $y = 0$.

8. Although the model is not game-theoretic, the notion of shareholders evaluating the proposal against what would occur if they reject the manager's request is closely related to the game-theoretic idea of (subgame) perfectness (Selten, 1975).

9. In the example of Appendix B, shareholders in fact want some positive level of defense, x. However, the manager wants still more.

References

DeAngelo,H. and Rice,E., Antitakeover charter amendments and stockholder wealth, **J.Financial Economics** 11 (1983) 329-360.

Easterbrook,F. and Fischel,D., Voting in corporate law, **J.Law and Economics** 26 (1983) 395-427.

Grossman,S. and Hart,O., Takeover bids, the free-rider problem, and the theory of the corporation, **Bell J.Economics**, Spring (1980) 42-64.

Jarrell,G. and Bradley,M., The economic effects of federal and state regulations of cash tender offers, **J.Law and Economics** 23 (1980) 371-407.

Jarrell,G., Poulsen,A. and Davidson,L., Shark repellents and stock prices: the effects of antitakeover amendments since 1980, mimeo, **Office of the Chief Economist, SEC** (1985).

Linn,S. and McConnell,J., An empirical investigation of the impact of 'antitakeover' amendments on common stock prices, **J.Financial Economics** 11 (1983) 361-399.

Romer,T. and Rosenthal,H., Political resource allocation, controlled agendas and the status quo, **Public Choice** 33 (1978) 27-43.

Romer,T. and Rosenthal,H., Bureaucrats vs voters: on the political economy of resource allocation by direct democracy, **Quarterly J.Economics** 93 (1979) 563-587.

Selten,R., Reexamination of the perfectness concept for equilibrium points in extensive form games, **International J.Game Theory** 4 (1975) 25-55.