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Takeover Bidding with Toeholds:

The Case of the Owner's Curse

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ABSTRACT

This paper demonstrates that winning a takeover bidding contest can be 'bad news' and, consequently, losing can be 'good news.' This is true even when all bidders act rationally in their own best interests with perfect information on their valuations. Bidders with toeholds rationally bid above their valuations and possibly suffer losses in equilibrium. This equilibrium strategy of 'bidding to lose' played by partial owners leads to the 'owner's curse.' The paper provides an explanation for acquirer losses without recourse to managerial 'hubris' and/or agency problems. The presence of partial owners also has strong implications for the choice of selling mechanisms: firms should not be sold using a first price sealed-bid auction. The presence of large blockholders also acts as a costless defensive measure and partially substitutes for other costly defensive measures. The model gives rise to predictions on (1) the type of acquirers more likely to make losses; (2) the choice of auction procedures; (3) the effect of managerial ownership on firm value; (4) the existence of initial bid premia; and (5) the incentives of firms to engage in share repurchase, private placement and debt-for-equity swaps in the face of a takeover threat.

1 Introduction

This paper provides a rational explanation for bidders with toeholds to possibly bid up to levels higher than their own valuations. The analysis, in addition to taking into account the strategic interactions between bidders, recognizes the stylized fact that many bidders in a takeover contest accumulate substantial toeholds before bidding.[1] While profiting from a toehold is not necessarily the primary objective of a blockholder, it plays a significant role in the formulation of his bidding strategy. In the event that a blockholder wins a bidding contest, it is then possible for him – even with strictly private valuations – to make a significant loss. Thus, an alternative rationale is provided to the hubris and/or agency conflict rationales to explain the large losses often incurred by acquirers.[2]

The first part of the paper shows that an incumbent-blockholder, who has some private benefits of control, finds it optimal to compete with a bidder without a toehold who values the target for the synergy gains that it may generate. The players' optimal bidding strategies in a progressive bidding contest are derived and the incumbent-blockholder is shown to be committed to bid up to a certain level above his own valuation before dropping out. For the incumbent-blockholder, winning the contest at a bid higher than his valuation can only result in an overpayment. Thus, winning is strictly 'bad news'. Since such overpayment is incurred only by a partial owner, it is referred to as the 'owner's curse'. This phenomenon, which may seem similar to the 'winner's curse' in common-values auctions[3] is, in fact, quite different. As is well known, the standard winner's curse problem goes away once bidders choose their optimal bidding strategies. Bidding with toeholds, however, is a completely different story: the optimal bidding strategy has an 'owner's curse' associated with it. The same considerations are later shown to hold even when the blockholder is capable of generating synergy gains of his own.

Additionally, the paper shows that due to partial ownership by a bidder, the private-values setup resembles somewhat a common-values one. The partial owner can gain not only because of his own high valuation but also from a competitor's high valuation. Thus a competitor's high valuation is no longer considered bad news, which is similar to a common-values setting

[1] Bradley, Desai and Kim (1988) report that a majority of acquiring firms had toeholds prior to bidding. They report a significant average initial stake of about 10%.

[2] Empirical studies have shown that (1) acquirer firms' share price appreciation at the time of acquisition is very low (Bradley, Desai and Kim (1988), Jarrell, Brickley and Netter (1988)); and (2) many acquirers suffer long term losses from the acquisition (Scherer (1988)).

[3] In a common-values auction, as opposed to a private-values auction, the full information valuation of the object is the same for all bidders.

and is in sharp contrast to a private-values one. Note that this effect is not due to a revision of valuations or to asymmetric information. Instead, the effect is solely due to the possibility of capital gains on the toehold.

Although progressive bidding is a common mechanism employed in the sale of large corporate assets, it is not the only one. In fact, a vast majority of corporate control transfers are mediated by investment bankers who effectively conduct auctions among interested acquirers. In running such auctions, investment bankers can choose among various auction formats. This paper compares two common auction mechanisms and derives a surprising result: the target/selling firm is strictly worse off with a first price sealed-bid auction than with a progressive bid auction. This result is in sharp contrast to the usual equivalence result found in the auction literature that assumes independent private-values and no toeholds (for example, Myerson (1981)). However, the result is similar to the affiliated-values case (for example, Milgrom and Weber (1982)). This seeming paradox is explained by the observation that it is incentive compatible in the progressive bid auction to execute a commitment to bid at inflated levels, due to the losing bidder's potential for capital gain on the toehold. However, such a strategy is not incentive-compatible in the first price sealed-bid auction.

Another interesting implication of takeover contests with toeholds is that they automatically provide a rationale for initial bids with premia built into them. Unlike in existing models, there is no need to have multiple players with private valuations of the target in order to generate premium bids. Moreover, the willingness to post an initial bid with a higher premium is not necessarily associated with a higher valuation on the bidder's part. Indeed, a higher toehold suffices to induce a blockholder to effectively impose a higher price level below which he will not permit a takeover attempt to go through.

The paper also shows that blockholders may act as costless defensive measures and contribute value to the firm even in the absence of monitoring considerations. This result implies that firms facing takeover threats may be better off increasing the effective block controlled by management. Such increases in block-size can be achieved by private placements, share repurchases or other leverage increasing strategies. Note that this advantage is not due to voting issues. Additionally, the opportunity cost of not having other defensive measures in place is decreasing in block-size. Thus, incorporating the blockholder's presence predicts that firms with smaller blockholders have a greater incentive to enact costly defensive measures like poison pills or golden parachutes.

To summarize, the paper makes the following predictions:

- The conditional probability of a loss-making acquisition is higher if a large blockholder wins the takeover contest.
- A large blockholder deters more acquirer types. Thus, the probability of a takeover attempt is smaller as the size of the blockholder increases.
- Target firms with significant blockholders choose not to be auctioned off under the first price sealed-bid format.
- Initial bid premia are increasing in the size of the block if the blockholder's valuation is publicly known.
- The profits of outside acquirers become smaller as the block-size and, consequently, the initial bid premium, increases.
- Firms are likely to undertake defensive measures like share repurchases, private placements or debt-for-equity swaps to increase the effective block-size in the face of a takeover threat.
- Firms with large blockholders are less likely to enact other defensive measures like poison pills and super-majority rules.

There are other papers in the literature that focus on the issue of toeholds. Grossman and Hart (1980) were most probably the first to point to the possible use of toeholds in alleviating the free-rider problem inherent in takeover bidding.[4] Shleifer and Vishny (1986) further developed this intuition. In their analysis, the acquirer is compensated for his costly investigative activities solely by the profits he makes on his toehold. Hirshleifer and Titman (1990) focus on share tendering decisions and allow the sole bidder to have a toehold before making a tender offer. Jegadeesh and Chowdhry (1989) extend the analysis to the case where the acquirer chooses his toehold strategically and develop a model in which the size of the toehold serves as a signal of the acquirer's valuation. The focus in this paper is quite different from that of these earlier papers. Here, for the most part, the free-rider problem is assumed away and, thus, an acquirer need not have a toehold in order to find it optimal to bid for a target. In addition, the bidding game itself provides the opportunity for the bidder to signal his valuation should he choose to do so.

The idea that a blockholder's existence enables the target firm to capture a bigger fraction of the total surplus is also related to some other papers in the literature. Israel (1991) shows

[4] See Bagnoli and Lipman (1988) and Holmstrom and Nalebuff (1992) for a possible resolution to the free rider problem.

that a target firm can capture some of the surplus (ex-ante) by issuing high levels of debt. The value of the debt improves with a high-type acquirer and the target firm obtains the expected value of this improvement at the time of debt issuance. Israel (1992) uses the ability of the blockholders to block takeovers to extract all the surplus from the bidder, including their private benefit of control. Stulz (1988) shows that an increase in the effective size of the incumbent blockholder, because of voting considerations, enables the target firm to extract more surplus from the acquirer. On a related note, Chowdhry and Nanda (1993) allow firms to issue debt with the same seniority as the existing debt, thus eroding the value of the old debtholders. They show that acquirer firms will have incentives to bid above their value in a takeover contest, thereby deterring entry.

In a contemporaneous paper, Burkart (1993) also explores the incentives of bidders with toeholds to bid above their valuations and independently derives results similar to some in this paper.[5] His focus, however, is strictly on overbidding and he does not consider the implications of these results for the defensive strategies of target firms or for initial bid premia. In addition, this paper focuses on the benefits to the target firm, leading to an exploration of the choice of sales procedures in which this tendency to overbid disappears. This paper, thus, shows that target firms should avoid these procedures. Burkart (1993) on the other hand, goes on to model the incentives to buy toeholds and sink information acquisition costs, an issue that is not discussed in this paper.

The paper proceeds as follows. Section 2 presents the basic model. Section 3 analyzes the case of the incumbent-blockholder with no private information. Section 4 generalizes the model to two-sided asymmetric information. Section 5 compares the revenues generated under standard auction procedures. Section 6 develops implications of incumbent-blockholdings for initial bid premia and the optimality of defensive measures. All proofs are collected in the appendix.

2 The Basic Model

Consider an all-equity firm which is a potential acquisition target. An acquirer may bring synergistic gains to the firm which are unique to him. There are three kinds of players. A majority of the firm's equity is held by a continuum of atomistic shareholders. These shareholders are assumed passive in that they are willing to tender to the highest outstanding

[5] We became aware of Burkart's working paper after the main results of this paper were developed.

offer in any acquisition contest. That is, the model abstracts away from the free-rider problem in Grossman and Hart (1980). In addition, there exists a single blockholder who holds an $\alpha\epsilon(0, 0.5)$ fraction of the firm's equity. The blockholder could be the incumbent manager, a passive investor or a potential outsider acquirer. The third player is a potential outside acquirer[6] without any holdings in the firm. All players are assumed to be risk neutral.

The value of the firm's cash flows to shareholders under the incumbent management is denoted by v_c, while the value of cash flows under the outsider's control is denoted by v_o. The blockholder provides competition to the outsider by participating in the bidding process. Cash flows generated under the blockholder's control have a valuation of v_b to him.

The outsider is assumed to discover the target firm with probability π.[7] Conditional on his discovery, he is assumed to costlessly observe his valuation, $v_o \epsilon[\underline{v}, \overline{v}]$, where v_o is distributed with a density function f(v), a distribution function F(v) and a hazard function H(v).[8] The hazard rate is assumed to be positive. Without loss of generality, $\underline{v}$ and v_c are normalized to 0. The current market value of the firm is denoted by v_m. Note that v_m is determined endogenously in the model.

On successful identification of the target, the outsider makes an acquisition offer. All acquisition offers are assumed to be cash tenders for all shares of the firm not held by the party making the offer. In particular, this implies that the outsider is required to make an offer to all shareholders, while the blockholder, if he chooses to participate in the bidding, has to extend a cash offer to (1-α) proportion of the shareholders. If the blockholder decides to contest the acquisition attempt, a progressive bidding contest ensues. As a matter of convention, we assume that the blockholder only has to match the outsider's outstanding offer in order for his bid to be considered more attractive. This assumption is partly motivated by the fact that the blockholder, unlike the outside bidder, already owns a fraction of the equity. Note, however, that the qualitative results do not, in any way, depend on this assumption.

The game is played as follows. The outsider makes the first bid and the blockholder decides to match or pass. If the blockholder matches, the outsider has the option to raise the bid only by an amount δ (where $\delta = \frac{(\overline{v}-\underline{v})}{n}$). The game continues until one of the players misses his turn and the other wins the contest and pays his bid. Imposing this rigid structure on the

[6]The potential outside acquirer is also referred to as an outsider.

[7]π can also be thought of as the probability that the outsider realizes a value greater than that of the current management. In that case, the conditional density function of the outsider's valuation will need to be used and, as such, the results will have a different functional form.

[8]The hazard function H(v) is defined as $\frac{f(v)}{1-F(v)}$. The hazard rate is just the derivative of the hazard function.

game allows us to solve the game via backward induction. The equilibrium concept used is one of sub-game perfection. [9] If the game reaches a specific node (defined by the outstanding bid) the relevant information set of the player at that node is a singelton consisting of the outstanding bid of the other player. It is shown that at every node the players have a dominant choice on whether to increment the bid. Finally for ease of exposition, the results are presented in the limit as $\delta \rightarrow 0$.

3 One-sided Asymmetric Information: The Incumbent Blockholder

Often the largest blockholder is the incumbent manager who derives some private benefits of control. The incumbent's private benefits of control are generally thought of as value-reducing to the atomistic shareholders because they introduce a divergence of preferences between shareholders and management. Specifically, the conventional wisdom has been that the resistance of managers to takeovers by more efficient rivals reduces the welfare of atomistic shareholders. In this section, the role of the incumbent in the capacity of a large blockholder is examined. The incumbent is often referred to as the blockholder. It is shown that the ownership of a large block, as well as private benefits of control, can be beneficial to atomistic shareholders.

The private benefits considered in this section are non-pecuniary and flow from managerial entrenchment. Some examples of benefits of entrenchment are the added prestige of managing a firm, an increase in outside opportunities with more experience, or the possibility of more outside directorships. Note that these private benefits improve the welfare of the incumbent manager but they do not impose a direct cost on the atomistic shareholders or the firm. However, the private benefits increase the incentives of the incumbent management to resist takeover activity and may impose an indirect cost on the shareholders.

[9] Hirshleifer and P'ng (1989) analyze a model with a discrete valuation space, in which bidding as well as investigation is costly. In their model the usual dominant strategy on an English auction, of bidding up to one's valuation, is no longer true. Bidders might drop out rather than bear the cost of bidding. The first bidder's initial bid, thus, deters investigation and also signals his valuation. In the current paper, the bidders are endowed with the information thus deterrence is not an issue. Bhattacharyya (1992) and Daniel and Hirshleifer (1992) have also shown the existence of an equilibrium in which the first bidder signals his value and, thus, deters competition. Later in the paper it is argued that this separating equilibrium is not robust to existence of blockholdings. This paper, thus, ignores bidding costs and focuses on the effect of blockholdings in a standard English auction like set-up. That is, signalling strategies are ruled out.

The incumbent's valuation of the benefits of control can be publicly known or can be the incumbent-blockholder's private information. The former case is analyzed here, that is, v_b is publicly known.[10] The first proposition shows that by virtue of his private benefits and partial ownership, the incumbent-blockholder has incentives to provide competition to the outsider. Specifically, the incumbent-blockholder is prepared to bid significantly above the valuation of the cash flows that the firm could generate under his control.

Proposition 1 *1. In a progressive bidding contest, the incumbent-blockholder with shareholding α is prepared to bid up to a level $\hat{z}\delta > v_b$, where*

$$\hat{z} = Max\left[z|\alpha \geq (z\delta - v_b)\frac{F[(z+1)\delta] - F[z\delta]}{\delta(1 - F[(z+1)\delta])}\right] \tag{1}$$

In the limit, as $\delta \to 0$, the blockholder is ready to match up to a price level $P(v_b)$, where

$$\alpha = (P(v_b) - v_b)H(P(v_b)) \tag{2}$$

2. The incumbent-blockholder contests any takeover attempt up to a level $P(v_b)$ strictly greater than v_b.

Proof(sketch): The progressive bidding contest is laid out as an extensive form game. Given the assumption that the blockholder has to only match an outstanding bid to win a round of bidding, it is clear that matching a bid is a dominant strategy conditional on a decision to revise the bid. Since the outsider is cognizant of this response, sub-game perfection requires working backwards through the game tree. The detailed proof, provided in the appendix, shows that the decision to contest by the blockholder is of the bang-bang variety. That is, there exists a point P(v_b), beyond which he will choose not to match but he will match all bids lower than P(v_b). ∎

The above proposition establishes the fact that it is not optimal for the blockholder to accept a bid just because it has a premium attached. This conclusion is true even though value would increase only on the transfer of control. What is striking about the result is that the blockholder is willing to bid higher than his valuation and sustain a significant loss in order to force the outsider to increase his offer. This would not be true if there were no

[10] It is easy to show that if there existed a credible method of communicating the value of the private benefit, the incumbent would do so. This communication would enable the incumbent to costlessly deter takeover attempts for low outsider types. This choice is not explicitly modelled in this paper: instead, it is assumed that the incumbent's private value is publicly known.

toeholds established prior to the commencement of the bidding. It is precisely this chance of profiting off the value enhancement of his toehold that gives the blockholder the incentive to compete.

Though the blockholder is willing to put in a bid higher than his private value, he has no desire to win the contest. In the event he wins the contest, the blockholder significantly overpays. Even though seemingly similar, this result is quite different from the 'winner's curse'[11] usually referred to in common-values auctions. In common-values auctions, the winner's preliminary value estimate is the maximum of all other estimates and is upwardly biased. Thus, the winner of the auction has the added information that everyone else's value estimate was lower than his, forcing him to revise his value estimate downwards. Sophisticated bidders can take into account this effect by shading their bids downward in a sealed-bid auction, basing their bids on the value estimate conditional on their winning the auction. Thus the 'winner's curse' goes away with sophisticated bidders. Here, however, the overpayment is not due to unsophisticated bidding. Instead, the blockholder knows with certainty that he will overpay on winning and still finds it optimal to bid at that level. As this overpayment is an artifact of partial ownership, this strong form of a 'winner's curse' is referred to as the *'owner's curse.'*

For the rest of the paper, the discrete grid is ignored and the limit result is assumed to hold. That is, the blockholder is assumed to be willing to provide competition to all outsiders with valuations below P(v_b).

Example: To illustrate the above result, assume that v_o is distributed uniformly over the interval [0,1] and v_b is also 0. Thus, the incumbent-blockholder has **no** private benefits of control. The blockholder provides competition up to a price P such that $\alpha = P.H(P)$. Using the definition of the hazard function,

$$\alpha = P\frac{f(P)}{1-F(P)} = \frac{P}{1-P}$$

in the limit, as $\delta \to 0$, the blockholder is willing to match up to price P, such that,

$$P = \frac{\alpha}{1+\alpha}$$

[11] An example of the winner's curse can be found in Capen, Clapp and Campbell (1971) describing auctions for oil drilling rights.

The valuation of the blockholder has been normalized to 0. It is apparent that the blockholder is willing to bid above his valuation. Thus, if the blockholder owns 30% of the firm and values the firm at zero, he would be willing to bid up to $\frac{\alpha}{1+\alpha} = 23\%$ of the maximum possible value. It is important to note that though the blockholder is willing to put in a premium bid, he has no desire to win the contest and hopes that the outsider will outbid him. $\blacksquare$

With only one outside acquirer, it is quite intuitive that the blockholder needs to provide credible competition to appropriate some of the surplus. However, there is no reason to believe that other outsiders cannot provide the same competition to the first bidder.[12] In this case it may appear that the blockholder can safely decrease the level of competition that he needs to provide. However, this observation is not true. The next result establishes that the blockholder's strategy is invariant across single- and multiple-outsider cases.

Proposition 2 *With outsiders having valuations distributed identically and independently with a positive hazard rate, the bidding strategy of the incumbent-blockholder in a progressive bid auction is invariant to the number of bidders.*

To get an intuition for the result, one has to ask the question whether the blockholder will match up to a bid higher than the case in which there was only one outsider. Given that the outsiders' valuations are independent, the distribution of the last-remaining bidder's value conditioned on the existing bid is no different from that of a single-outsider's distribution conditioned on the same existing bid. This fact can be used to show that the blockholder will not find it optimal to match at a price higher than that for the single-outsider case. *As a result, for the rest of the paper, we assume that there exists only one outsider.*

The progressive bidding contest could, in principle, start from the lowest point in the support and ratchet up to the point where one bidder drops out of the contest. Since the blockholder's strategy is common knowledge in equilibrium, it is known that the blockholder will match all bids below $\mathrm{P}(v_b)$. Thus, there exist numerous sequences of bids where the outsider can start the bidding at any price below $\mathrm{P}(v_b)$, but will always have to buy the firm for $\mathrm{P}(v_b)$. With existed some costs of delay, the outsider will not find it optimal to put in a bid which will have to be revised upwards with probability 1. That is, the outsider will find it optimal to start the bidding at $\mathrm{P}(v_b)$. As a result, any equilibrium which is robust to an introduction of such costs entails a take-it-or-leave-it offer at $\mathrm{P}(v_b)$, that is accepted. In this

[12] Berkovitch and Narayanan (1993) report that 60% of the firms in their sample of successful takeovers received a single bid.

paper, such an equilibrium is referred to as a robust equilibrium. Corollary 1 characterizes the robust equilibrium. In the rest of the paper attention is restricted to robust equilibria.

Corollary 1 *With costs of delay, in a robust equilibrium,*

1. *All outsiders with valuations less than $P(v_b)$ do not bid;*
2. *All outsiders with valuations above $P(v_b)$ bid $P(v_b)$; and*
3. *The blockholder does not incur losses in equilibrium.*

The effect of block-size on the minimum price conditional on a takeover, the probability of a takeover and the profits of the outsider is unambiguous. The bigger the block the higher the price up to which the blockholder is willing to compete with the outsider. Consequently, a bigger block ensures that the firm gets a higher price conditional on a successful takeover. Thus, outsider profits are decreasing in block-size. However, the probability of a takeover happening is also decreasing in block size. The proposition below presents these comparative statics.

Proposition 3 *An increase in the block-size results in a:*

1. *Higher price conditional on takeover;*
2. *Lower probability of takeover; and*
3. *Lower outsider profit for every realization of the outsider's valuation.*

The effect of block-size on the market price, however, is not so obvious. With probability π, the outsider identifies the target. Then the outsider takes it over by paying the price P(v_b) if his valuation is above P(v_b). Thus, the market value of the firm is given by

$$v_m = \pi\,[F(P(v_b))\,0 + (1 - F(P(v_b)))P(v_b)] = \pi P(v_b)(1 - F(P(v_b))).$$

Note that the term in parentheses on the right is decreasing in P(v_b). Thus, it is not clear that v_m is increasing in P(v_b). However, for v_b=0, the incentives of the blockholder are perfectly aligned with those of the firm and the atomistic shareholders. P(v_b) is optimally chosen by the blockholder and is always optimal for the firm value if v_b=0. The intuition is not so clear when the blockholder has some private benefits. In the robust equilibrium the blockholder may end up deterring the outsider to levels higher than the firm-value maximizing levels. The next proposition gives conditions under which the market value of the firm is increasing in block-size.

Proposition 4 *1. For every $v_b < K^*$ where $K^* H(K^*) = 1$, there exists an $\hat{\alpha}(v_b)$ such that the market value of the firm is increasing in α [for $\alpha < \hat{\alpha}(v_b)$].*

2. Specifically, for v_b=0, the market price is increasing for every α.

Mikkelson and Ruback (1985) show that the value of a target firm substantially increases whenever someone acquires a toehold of 5% or more. The increase is significant even when the blockholder declares that the block is for investment purposes only. Proposition 4 establishes that even in the absence of any signalling of future takeover activities or any voting considerations, the establishment of a significant toehold may enhance market value. Since no signalling stories need be invoked to explain the Mikkelson and Ruback (1985) result, it should be apparent that such an increase in the price need not be temporary. Although Mikkelson and Ruback (1985) do not pursue the issue of whether the stock price valuation they document is long-term or not, it would be interesting to see whether the data supports a long-term enhancement of market value even when subsequent events do not entail a takeover attempt. What is innovative about this result is that the information that is communicated to the market by the increased holding is not of the asymmetric variety. The mere establishment of the toehold credibly commits the blockholder to a different strategy in the future, which leads to the current value enhancement.

Example: The intuition behind the above proposition can be illustrated by solving for the optimal α, assuming that v_o is uniformly distributed over the interval [0,1]. Assume that the incumbent's value of benefits of control is 0.3. The optimal α can then be shown to be 40%, and the price up to which the incumbent will deter is 0.5. Surprisingly, such a high private benefit of control ends up helping the atomistic shareholders even when it is publicly known. $\blacksquare$

Stulz (1988) also shows that the value of the firm increases with the size of the incumbent's block as it reduces the shares available to an outsider.[13] Stulz, however, assumes that the

[13] Stulz assumes that the supply curve of tendered shares is upward sloping in the premium offered to the

incumbent does not compete with the outsider for control. Instead, the outsider's presence just reduces the probability of success. In contrast, in this paper the incumbent is committed to compete at all prices below $P(v_b)$, consequently, the advantage of the incumbent's block is not due to voting considerations.

Propositions 1 and 4 help rationalize management's attempts to buy the firm in the face of an hostile takeover. In doing so, management is often accused of not acting in the shareholders' interest.[14] The premium the managers are ready to pay for the firm is cited as evidence of managers' unimplemented ability to improve the firm. Proposition 1, however, demonstrates that the premium the manager is ready to pay for the firm may instead be an indicator of his private benefit. This result also establishes that if the management team attempts a buyout and is forced to bid higher than its initial bid due to competition, it does not necessarily imply that the management team was 'stealing the firm' at its initial bid.[15] Such bidding in the face of competition is, in fact, beneficial to the shareholders and may even be at the cost of the incumbent management. Atomistic shareholders, although desirous of takeover challenges in the face of entrenched management, nevertheless gain from the management's benefits of entrenchment.

4 Two Sided Asymmetric Information: Blockholder with Private Information on Synergies

In the previous section, the blockholder was the incumbent who had no incentive to acquire the firm outside the context of a bidding contest. In general, however, the blockholder may be an outsider, who also has access to some synergies. In this section, the blockholder is assumed to be privately informed about his own valuation (v_b) and, v_b and v_o are i.i.d. with density functions of f(v) over $[0,\overline{v}]$. As a result, the blockholder is best thought of as a potential acquirer who has gained a toehold up-front. Therefore, unlike the previous section, the blockholder has incentives to acquire the firm even in the absence of a competing bidder.

atomistic shareholders and that the target management values control so much that it never tenders. As a result, a large block in the hands of the incumbent reduces the probability of success and forces the outsider to increase the bid. Thus, an increase in the incumbent's block increases the bid premium. However, the increase also reduces the probability of a successful takeover and, thus, leads to an interior optimal block-size.

[14] See Jensen and Meckling (1976).

[15] This paper does not attempt to explain or defend the motives of the management team. The results demonstrate that providing competition to the outsider does not necessarily prove the accusation made by the popular press to be true.

The blockholder's bidding strategy now depends not only on the size of his block but also on his private valuation. The possibility of a blockholder bidding above his value generalizes to this setting.[16]

Corollary 2 *1. Even when the blockholder's synergy is private information he is still willing to compete up to the same price level as when the synergy is publicly known. That is, the blockholder is ready to match up to a price level $P(v_b)$, where*

$$\alpha = (P(v_b) - v_b)H(P(v_b))$$

2. The blockholder contests any takeover attempt up to a level $P(v_b)$ strictly greater than v_b.

The incorporation of possible synergy gains on the part of the blockholder changes the problem under analysis from a situation with one-sided asymmetric information to one with two-sided asymmetric information. However, the outsider was playing his dominant strategy in the previous section, which did not depend on the realization of the blockholder's valuation. Thus, the same result goes through. The proof of the above corollary is omitted as it directly follows from the proof of proposition 1.

In this section, the generalization allows for the possibility of contests to occur. As a result, there now exists the possibility that, in the process of trying to extract surplus from the outsider, the blockholder ends up incurring a loss with positive probability. The 'owner's curse' considerations introduced in the earlier section now become an equilibrium outcome.

Proposition 5 *If the blockholder's value is not publicly known, he incurs a loss (overpays), with a strictly positive probability.*

Empirical studies have discovered that over the long term, from one to three years, acquirer firms incur losses.[17] These losses, though not statistically significant, are a little puzzling. Event studies on takeovers have reported that the stock market also considers many acquisitions 'bad news' for the acquirer firms.[18] In fact, average profits over the acquisition period

[16] In fact, the result that the blockholders are willing to bid strictly above their private value generalizes to the presence of multiple blockholders. A closed form solution is presented in proposition 6.

[17] See Jensen and Ruback (1983) and Scherer (1988).

[18] See Mikkelson and Ruback (1985), Bradley, Desai and Kim (1988) and Berkovitch and Narayanan (1993).

are not significantly different from zero. Previous work has identified a few possible reasons for acquirers to incur losses in equilibrium. One explanation given is that the managers are less informed than the market about the valuation of the target. Thus, there will exist instances when the acquiring managers make valuation mistakes but the market price reflects the true values. However, it is not clear why managers do not withdraw their bid, if valuation error is the source of losses, when they observe the market's negative reaction. Typically, managers instead raise the bid even after observing a negative reaction to their initial bids.

Agency problems have been identified as another possible cause for loss making-acquisitions. Managers of acquiring firms may not be acting in the best interests of shareholders while making acquisition decisions. Several motives have been assigned to managers for going on an acquisition binge. Some examples are diversification of managers' personal portfolios (Amihud and Lev (1981)), use of free cash flow to increase the size of the firm (Jensen (1976)), and an increase of the firm's dependence on management (Shleifer and Vishny (1989)).

Roll (1986) puts forward the 'hubris' hypothesis to explain why many acquiring firms incur losses. The hubris hypothesis closely parallels the 'winner's curse'. Suppose there exist no possible gains to takeover activity. Managers, according to Roll, trust their own valuations more than they trust the market valuation. Takeovers will be attempted only when the managers believe they have found undervalued firms. If the market's and managers' valuations (in an expected sense) are both correct, takeover attempts will only occur in firms where managers' estimates are biased upward. As a result they will incur losses in takeovers. Managers, because of their hubris, refuse to account for the biases in their estimates. Consequently they suffer losses, exactly the behavior of unsophisticated bidders in a common-values auction who do not adjust for the 'winner's curse.'

This paper predicts that some of the losses observed in long term studies could well be due to the 'owner's curse.' The blockholder can gain from the higher valuation of the bidder through capital gains on his block. Thus, a blockholder has incentives to increase the bid to capture some of the rents on his block. Similar to the common-values problem, there will exist instances when the blockholder will end up ratcheting up to and winning at a price above his valuation. Thus the assumed private-values set-up resembles a common-values problem. Note, however, that in this model the blockholder knows while putting in a bid that he will incur a loss on winning but still finds it optimal to do so. In contrast, the sophisticated common-values bidder adjusts his bid strategy to the point that he expects to gain on winning the bid.

This section has shown that the 'owner's curse' becomes an equilibrium outcome with two-sided asymmetric information. The blockholder contests the outsider's bids when he has private information on the synergistic gains he can bring to the table. As the degree of competition provided depends on the value realization of the blockholder (his private information) there exist instances when he incurs a loss in equilibrium. This loss is surprising because it is not due to evaluation errors or agency conflicts. In fact, the bidder knows with certainty that he will incur the loss if the bid is successful.

The results of this section are similar to those in Burkart (1993). He analyzes a second-price auction and shows that bidders with toeholds overbid. He goes on to show that overbidding also occurs in an ascending bid auction. In Burkart's model, contests always take place and, more importantly, control is always transferred to either the blockholder or the outsider. This paper, by analyzing a well specified, extensive form process and by focusing on the notion of a robust equilibrium, shows that the deterrence achieved by the blockholder reduces his losses relative to those when he is always forced to bid by assumption. These considerations are especially important in situations where the blockholder's valuation is publicly known or where the blockholder is the incumbent. Moreover, as the next section shows, the incentive to overbid goes away when the sealed-bid auction employs the first price rule, which is the most common rule employed in this context. As a result, this paper also establishes the superiority of progressive bid contests from the point of view of atomisitic shareholders.

5 Choice of Auction Format

Takeover bidding is best described by a progressive bidding contest. However, this is not the only way corporate control is transferred.[19] Sometimes the Board of Directors hires an agent[20] to sell the firm. This section examines the incentives of the blockholder and the outsider in a sealed-bid first price auction and compares the resulting expected revenue with that under a progressive bid auction. The question asked is simple: is there an advantage to selling the firm under a progressive bid auction?

This question is interesting because in an independent private-values setting with risk-neutral bidders, the progressive bid auction and the first price auction generate the same

[19] In fact, a significant number of mergers are initiated by the seller without the backdrop of a competitive bidding situation.

[20] For example, RJR Nabisco's Board of Directors hired a law firm to run an auction in the later stages of the contest.

expected revenue for the seller.[21] This result cannot be directly applied here because one of the potential bidders, the blockholder, owns a fraction of the object to be auctioned. That is, he may gain from his opponent winning the auction and may incur losses if he wins himself, which gives rise to the 'owner's curse' mentioned earlier.

The first price auction is the most prevalent format for sealed-bid auctions.[22] In this setting, the loser cannot directly influence the price paid by the winner. However, in the progressive bid auction, the loser can influence the price paid by the winner by competing up to a certain price level. This difference has important implications when bidders have toeholds. Specifically, the next proposition establishes that in the context of a sale to bidders who may already have toeholds, it is not optimal for the target firm to conduct a first price sealed-bid auction.

In this section we assume that there exist two blockholders with symmetric block-sizes (α). The blockholders have private information on their independently drawn value from the uniform distribution over the interval [0,1]. Given these assumptions the next proposition shows that the progressive bid auction generates a higher revenue than the first price sealed-bid auction. The example following the proposition shows that the result is also true in the one-sided asymmetric information case.

Proposition 6 *If the firm has two blockholders with symmetric holdings and valuations are i. i. d. uniform [0,1] then the progressive bid auction has a strictly greater expected revenue for the target firm than the first price sealed-bid auction.*

In a progressive bid contest, a blockholder bids above his valuation to try and obtain some of the surplus from the other bidder. He does this because his bid not only affects the probability of selling the firm to the other bidder but also establishes the price at which it is sold to the other bidder. In a first price auction, the blockholder's bid only affects the probability of selling the firm to the other bidder and does not, in equilibrium, *directly* affect the price paid by the outsider. Thus, in this auction format, the blockholder has a reduced incentive to put in a bid higher than one with no blockholding.

[21] Revenue equivalence theorem (Myerson (1981) and Riley and Samuelson (1981)).

[22] This prevalent choice by sellers could be in response to bidder risk-aversion (Mathews (1980) and Maskin and Riley (1984)) or the ability of bidders to collude in the second-price auction format (Back and Zender (1993)).

Example: To clarify the intuition for the above proposition we solve for the equilibrium in a one-sided asymmetric information case with one blockholder who has no synergies [v_b=0]. From proposition 1 the blockholder in a progressive bid auction would be willing to bid up to P(0), which is greater than 0. Thus, the expected revenue of the firm in this auction would be given by, $Prob[v_o > P(0)]P(0)$ which is positive.

For the first price sealed-bid auction, let the outsider's bidding function be b(v). In this one-sided asymmetric information example it is not possible to use the concept of a symmetric Nash equilibrium as is often done for the two-sided asymmetric information case. Thus, to choose a particular equilibrium, players are restricted from playing weakly dominated strategies.[23] The blockholder's bid of 0 is first shown to weakly dominate all other positive bids (K). The following table provides the payoffs of bidding any positive number K and that of bidding 0.

Payoffs to the blockholder.

	Bidding K:	Bidding 0:
If $b(v) > K$	$\alpha b(v)$	$\alpha b(v)$
If $b(v) < K$	$-(1-\alpha)K$	$\alpha b(v)$

From the table above, bidding 0 weakly dominates bidding any positive K for all b(v), specifically for b(v)=0. The best response to the blockholder bidding 0 is b(v)=0. Thus, the expected revenue for the firm is zero which is strictly less than that of the progressive bid auction. ∎

Although the outsider's valuation for the firm is purely private, the establishment of a toehold by the blockholder gives him a stake in the outsider's valuation. As far as the blockholder is concerned, a higher valuation on the outsider's part is 'good news' as opposed to the no-toehold case in which a higher valuation for the opponent is always 'bad-news.' The toehold introduces elements of a common-values problem into the bidding framework. However, the common-values feature alluded to above is not informational in nature. That is, knowledge of the opponent's valuation does not cause the blockholder to revise his own valuation estimate.

Thus, it is not surprising that due to these elements of common-values the choice of a sale procedure resembles the one predicted by affiliated-values models. Milgrom and Weber

[23] The same equilibrium can by obtained by restricting attention to equilibria which are trembling hand perfect.

(1982) show that if bidders' valuations are affiliated, the second price auction is dominated by an ascending bid auction. They use the 'linkage principle' to explain the above result: bids in an ascending bid auction convey valuation relevant information to all bidders. Thus, a higher bid by one bidder positively influences valuation estimates of all other bidders. An ascending bid auction exploits this ability of bidders to condition their valuations on other bidders' bids and improves the seller's expected revenue by enhancing competition.

6 Implications of Incumbent Blockholdings:

6.1 Initial Bid Premia:

Empirical studies have concluded that initial bids in takeovers are almost always at a significant premium over the market price.[24] This section shows that the existence of a blockholder may well lead to an initial bid premium. It has already been established in an earlier section that in the robust equilibrium, the outsider starts the bidding at a level not less than the price up to which the blockholder is committed to contest. If the original market price is less than this price level, the first bid will be at a premium. The next proposition establishes sufficient conditions for initial bid premia to arise.

Proposition 7 *In the robust equilibrium the initial bid will be at a premium if the probability of the target being discovered (π) is small enough.*

P'ng (1986) and Fishman (1988) explain the existence of initial bid premia by showing that outsiders have an incentive to put in a preemptive bid to signal their valuations and avoid competition from other potential acquirers. In Fishman's model, a high type acquirer's premium bid signals his type and preempts the competitor's investigation. Bhattacharyya (1992) and Daniel and Hirshleifer (1992) show that the signalling intuition is robust, even when there are no investigation costs. They show that a separating signalling equilibrium exists where the high type acquirer chooses to put in a higher bid. Thus, a larger set of competitor types is deterred.

The signalling equilibrium, in Bhattacharyya (1992) and Daniel and Hirshleifer (1992), is not robust to target shareholders' ability to subsidize another outsider for providing competi-

[24] For example, Bradley (1980) reports that the average price paid was 49% higher than the price two months before the offer.

tion to the first bidder. If there exists a blockholder, then he himself can provide competition. Thus, he can extract all the surplus by bidding just below the valuation of the outsider, which is known in a separating equilibrium. The possibility of such an action by the blockholder kills the incentives of high type acquirers to separate themselves.

In this paper, initial bid premia, arise not because the outsider bids to signal his valuation but because the blockholder's presence forces him to do so. The blockholder deters the low type outsiders and the high type outsiders pay at least $P(v_b)$ to get the firm. If the blockholder is the incumbent, or if he cannot bring any synergies to the firm, then he does not bid in the robust equilibrium. Thus, either the takeover is successful at price $P(v_b)$ or it does not take place. The market price is just the expectation of the value in two mutually exclusive events and is, consequently, less than $P(v_b)$. If the blockholder is not the incumbent, then the same logic gives rise to initial bid premia as long as the market value is close enough to v_c.

In the current paper, the size of the premia is invariant to the valuation of the outsider. In this model, higher initial bid premia are due to a high $P(v_b)$, and will be associated with lower outsider profits and not higher outsider profits as some of the extant literature suggests.[25] This prediction is empirically testable. Another testable implication of proposition 7 is that firms with large blockholders will have higher bid premia compared to firms with smaller blockholders. An increase in block-size has a first-order effect on the initial bid and a second-order effect on the market price. An increase in α increases $P(v_b)$ and will thus increase the initial bid premium. The next corollary summarizes the above assertions without proof.

Corollary 3 *1. The initial bid premium is increasing in block-size.*

2. Lower outsider's profits are associated with higher initial bid premia.

6.2 Takeover Defense by Increasing Block-Size

The previous sections have demonstrated that the existence of large blockholders reduces the probability of a takeover. Their presence also helps target shareholders appropriate a larger fraction of the surplus from an outsider. This section shows that some of the prevalent takeover defenses may be attempts to increase the effective block-size. Though they reduce the probability of a takeover, they are still beneficial for small shareholders.

[25] For example, Hirshleifer and Titman (1990), Bhattacharyya (1992) and Daniel and Hirshleifer (1992).

6.2.1 Private Placements and Share Repurchases

There exists some anecdotal evidence that managers use private placement of equity in as a takeover defense. The model developed in this paper helps identify the advantage to shareholders of private placements. Even if a firm can place shares at the current market price (which will be lower than the ex-placement price), it will choose to place at least a fraction of its total shares with a single, self-interested blockholder like the incumbent. It might seem that by placing shares at a price lower than the ex-placement price the firm is acting irrationally, giving wealth away. However, this presumption is not true. Instead, by doing so, it can expropriate some of the surplus of a potential bidder and make existing shareholders better off. The above intuition is summarized, without proof, in corollary 4.

Corollary 4 *Placing blocks in the hands of incumbent management can improve the welfare of small shareholders even if it is done at the pre-placement price which is strictly lower than the ex-placement price.*

Example: An example will clarify the above intuition. Assume that the outsider's value (v_o) is distributed uniformly over [0,1]. If the firm could place a fraction α with a blockholder, then he will deter all outsider types up to $\frac{\alpha}{1+\alpha}$, and force all outsider types in the upper pool to pay $\frac{\alpha}{1+\alpha}$. The firm will choose the optimal α to maximize the value of the remaining fraction. In this example, the expected value of the remaining firm is just

$$(1-\alpha)\frac{\alpha}{1+\alpha}\left[1-\frac{\alpha}{1+\alpha}\right]$$

which is maximized at $\alpha = \frac{1}{3}$. For $\alpha = \frac{1}{3}$ the total firm value is $\frac{3}{16}$ and the value for the atomistic shareholders is $\frac{1}{8}$

However, if the firm has no blockholders its value will be equal to the value under the current management, which has been normalized to 0. Put differently, the firm has no bargaining power without blockholders, and will get the bottom of the support of outsider's valuation.

The example illustrates the advantage of having a block even if it is given at the current price of zero. ∎

Share repurchases can also increase the firm's current value by effectively increasing the block-size and, consequently, capturing a larger fraction of the surplus conditional on a successful takeover. Stulz (1988) has a similar result. He shows that, because of voting considerations, firms can benefit by repurchasing shares before, or in the midst of, a takeover battle. In the current paper, the benefit of effectively increasing the block-size is not due to voting considerations. Instead, the benefit is due to the enhancement of the blockholder's pre-commitment to compete.

Consider now a firm which has a small blockholder and is confronted with a choice between paying a cash dividend or repurchasing shares. Both decisions equally affect the cash resources and the total value of the firm under current management. However, the share repurchase increases the block-size and, thus, the firm is able to appropriate a bigger fraction of the surplus conditional on a successful takeover. Consequently, the firm value is greater after a share repurchases than after disbursement of a cash dividend. This is summarized, without proof, in the next corollary.

Corollary 5 *For a small initial block-size, a firm will be better off repurchasing shares rather than paying out cash dividends.*

Example: Assume a uniform distribution on v_o over the support [1,2]. Let the value of the firm's cash flow under current management be 1 and let the size of the blockholder be 10%.[26] The firm has excess cash of 0.1. If it pays it as dividend, the cum-dividend value of the firm can be calculated to be 1.1826, where 0.0826 is the expected gains from takeover. If, instead, the firm opts for a share repurchase from atomistic shareholders, the block-size is 10.92%, and the per-share firm value can be calculated to be 1.1887, which is greater than before. The change in per-share firm value is due to an increase in expected gains from a takeover, which are now equal to 0.0887. ∎

Dann and DeAngelo (1988) study the restructuring decisions of 39 firms facing hostile takeovers. There is ample evidence in their sample of firms consolidating blockholders' positions via private placement (14 firms) and share repurchases (8 firms). Out of their sample of 39, 3 firms engaged in both private placement and share repurchases, which is even stronger evidence of the advantage of consolidation of blocks in the face of a takeover threat.[27]

[26] The normalization of v_c to 0 is inconvenient here and is therefore relaxed.

[27] Although these facts match with the prediction of the previous results, contrary to the prediction here the market on average did not react favorably to these transactions.

6.2.2 Short-Term Capital Structure Changes

The model developed in this paper also has implications for short term capital structure changes brought about in the face of a takeover threat. Issuing debt or preferred shares in lieu of stock will consolidate the holding of the blockholder and help the firm appropriate a larger fraction of the surplus. Thus, the model predicts that takeover targets would load up on debt with either a debt-for-equity swap or by issuing new debt and repurchasing stock. The intuition is similar to the share-repurchases example with cash in hand and is summarized, without proof, in the next corollary.

Corollary 6 *Potential takeover targets will gain by undertaking debt-for-equity swaps.*

It is important to note that the prediction of the above corollary is not due to changes in voting rights, even though it matches with that of Harris and Raviv (1988) and Stulz (1988). We are not aware of any empirical study that rigorously studies the incentive of firms to increase leverage in the face of a takeover threat. Harris and Raviv (1988) report that Herztberg(1985), in a Wall Street Journal article, claimed that takeover targets increase debt levels.

6.2.3 Stock Compensation

Another implication of the above proposition is that paying the managers with stock of the firm or stock options is better than paying them cash even in the absence of agency considerations. Compensating by stock increases the block controlled by the management and helps the atomistic shareholders in extracting more surplus from the outsider. The advantage of issuing stock options is quite similar. If the managers can increase the price the firm gets in a takeover contest, it naturally increases the value of their stock options.[28] The above intuition is summarized, without proof, in the next corollary.

Corollary 7 *If the manager owns a small block, granting stocks or stock options as compensation to the manager increases $P(v_b)$ in the case of a takeover attempt and can improve the welfare of stockholders.*

[28] Assuming the stock options are still valid after a successful takeover or can be exercised on or before the tender date.

6.3 Implications for Defensive Measures

Share repurchases, private placements of equity, short-term capital structure changes and stock compensation plans discussed above are examples of firms taking steps to extract more, in expectation, from outsiders. These are not the only possible measures firms could take to gain a better position in a takeover contest. Firms that believe they are potential takeover targets often erect barriers to takeover activity by enacting other defensive measures like poison pills, super-majority rules, golden parachutes, dual-class shares and staggered boards. These defensive measures tilt the playing field in favor of the incumbent management in any control contest. It may seem that the benefit to the incumbent management is always at the cost of existing shareholders. This observation, however, is not true. We next study the advantage of these measures to target firms.

One can view defensive measures like poison pills as commitment mechanisms that the incumbent management will repeal, or be forced to repeal by the courts, when faced with a high enough offer. Such a defensive measure lowers the probability of a takeover but increases the price paid conditional on a takeover. Such defensive measures do allow for entrenchment and are potentially costly.

As far as the firm is concerned, an incumbent blockholder, especially if he has no private information, is isomorphic to such a defensive measure. He deters low-type acquirers and ensures that high-type acquirers pay a minimum price. The optimal tradeoff between the probability of takeover and the price received conditional on a takeover can be obtained by picking the appropriate block-size. The incumbent will act strategically to maximize the private benefit of control and the value of the block.

One implication of the above assertion is that firms with large blockholders have a smaller increase in firm value by putting a defensive measure in place. Thus, firms with large blockholders have less incentives to enact defensive measures, especially if defensive measures have associated costs. The above intuition is stated without proof in the next corollary.

Corollary 8 *The disadvantage of not having an optimal induced defense is decreasing in α. That is, firms with small blockholders have a greater incentive to enact costly defensive measures.*

There exists some weak evidence supporting this prediction. A poison pill provision is an example of a costly defensive measure. Malatesta and Walkling (1988) report that firms in which the management team owned lower than average stock holdings were more likely to enact poison pill provisions. Their reasoning for this result is quite different from that advanced in this paper. They argue that if managers own a higher fraction of the firm, they bear a higher cost, due to a lower stock price, of enacting such provisions.

7 Conclusion and Possible Extensions

This paper has analyzed the behavior of bidders who have already gained a toehold in a takeover contest. These blockholders could be passive investors, outsider acquirers or the incumbent management. It has been shown that a blockholder, because of his partial ownership, suffers from an 'owner's curse.' That is, in order to extract greater surplus from another acquirer, a blockholder has an incentive to bid above his valuation and possibly suffer significant losses in equilibrium. The 'owner's curse' is different from the well known 'winner's curse' that occurs in common-values auctions. Thus, the paper has provided an explanation for bidders to rationally incur losses in equilibrium without recourse to agency problems or hubris even though there is perfect knowledge of private valuations.

Firms with blockholders are shown to have a strict preference for a progressive bid auction, which is the most prevalent mechanism. More importantly, it has been shown that the intuition gained from analyzing sale procedures without toeholds does not extend to the presence of blockholdings. For a progressive bid contest, the existence of of initial bid premia in the presence of blockholdings has also been demonstrated.

The existence of a blockholder has been shown to benefit the firm, specifically the small atomistic shareholders. Blockholders act as surrogate defensive measures helping the small shareholders appropriate a larger fraction of the surplus from the acquirer. The defense provided by a large blockholder is costless and the commitment of the blockholder to compete does not suffer from any credibility problems. Firms can increase the effectiveness of a blockholder defense by optimally adjusting block-size. This result can be one possible reason for firms to engage in private placements, share repurchases or debt-for-equity swaps in the face of takeover threats. The model also shows that firms with relatively smaller blockholders have greater incentives to enact defensive measures like poison pills and super-majority rules et cetera.

It has also been shown that the incumbent management's incentive to resist a takeover, because of their private benefits of control, can be used to improve the welfare of atomistic shareholders. Such incentives can be forever enhanced by making the incumbent a large blockholder. Thus, the paper identifies another reason, other than that of aligning incentives, for granting stock rights and stock options to managers. In addition, it has been demonstrated that a premium bid put in by incumbent management to provide competition does not necessarily imply that the management team was not earlier acting in the shareholders' interest. Nor does it necessarily imply that the management is attempting to 'steal the firm.' Recognizing the incentives of management to provide competition helps explain the incidence of loss-making MBOs.

Appendix

Proof of Proposition 1: The proof is by backward induction. In an progressive bid contest the dominant strategy for the outsider, who has no blockholdings, is to increment his bid up to his valuation. Given the outsider's dominant strategy the blockholder's best response is derived here. The blockholder has the option to match every bid by the outsider. He will not match the outsider's bid at $(n-1)\delta$ because then he will win the bidding game with probability 1 and thus make a loss for sure (assuming δ small enough such that $v_b < (n-1)\delta$). This is true because the only way he can not make a loss is if the outsider bids $\overline{v}$ which is a zero probability event. Next, we can examine whether he would match a bid at $(n-2)\delta$, given that he will not match at $(n-1)\delta$ and so on. Define p_z as the probability of the outsider incrementing his existing bid of $z\delta$. Thus, p_z is the conditional probability of the outsider's valuation being greater than $(z+1)\delta$ conditional on its being greater than $z\delta$ $[Prob[v > (z+1)\delta | v > z\delta]]$.

Let $z\delta$ be the maximum bid that the blockholder is willing to match, that is by backward induction we find that it sub-optimal to match at $(z+1)\delta$. Thus, the blockholder will be ready to match the bid up to the maximum z which satisfies the following inequality.

$$\begin{aligned} \alpha\, z\, \delta &< p_z \alpha(z+1)\delta + (1-p_z) * (v_b - (1-\alpha)z\delta) && (3) \\ \alpha &\geq (z\delta - v_b)\frac{(1-p_z)}{(p_z\delta)} && (4) \end{aligned}$$

Once we recognize that p_z is just $\frac{1-F[(z+1)\delta]}{1-F[z\delta]}$, 4 simplifies to

$$\alpha \geq (z\delta - v_b)\frac{F[(z+1)\delta] - F[z\delta]}{\delta(1 - F[(z+1)\delta])} \tag{5}$$

For $z\delta \leq v_b$, the $RHS \leq 0$ which implies the inequality is satisfied and the blockholder will match the bid up to v_b. For z=(n-1), as argued before RHS is ∞ and and the blockholder will never match at $(n-1)\delta$. Strictly positive hazard rate implies that the RHS is increasing in z. Thus, there will exist a $\hat{z}$, for $0 < \hat{z} < (n-1)$, such that for all $z < \hat{z}$ the inequality will be satisfied and the blockholder would be willing to match all offers at all $z\delta$.

The limit result: Replacing $z\delta$ with P in the RHS of equation 5 we get

$$(P - v_b)\frac{F[P+\delta] - F[P]}{\delta(1 - F[P+\delta])} \tag{6}$$

As δ approaches 0, $(\frac{F[P+\delta]-F[P]}{\delta})$ approaches $f(P)$ and $F[P+\delta]$ approaches $F[P]$. Using the definition of the hazard function, equation 6 reduces to

$$\alpha = (P(v_b) - v_b)H(P(v_b))$$

The RHS is strictly increasing in $P(\cdot)$, is equal to 0 at $P = v_b$ and is unbounded from above as P approaches $\overline{v}$. Thus, there will exist a P(vbper) which satisfies the above equality. ∎

Proof of proposition 2: The dominant strategy of all bidders without toeholds is to bid up to their valuation. As a result, as long as there exist two bidders who are competing in the auction the blockholder need not enter into bidding. The relevant question, then, is whether the blockholder should match the highest bidder if he is the only one left. But that is exactly the same problem as the single outsider one. Specifically, assume that all bidders except one drop out at a price $\hat{P}$, and the blockholder has a choice whether to match the bid of the remaining bidder. The conditional density of the remaining bidder is exactly the same as the conditional density of a single bidder being above $\hat{P}$. Given the privateness of valuations, all other bidders' valuations being below $\hat{P}$ gives no new information to the blockholder. Thus, the problem is isomorphic to the single bidder case. If he was ready to match at $\hat{P}$ he will do the same now. ∎

Proof of proposition 3: All we need to show is that the price level P up to which the blockholder is willing to match is increasing in α. The relevant P is the solution to

$$\alpha = (P(v_b) - v_b)H(P(v_b))$$

The right hand side of equation 2 is increasing in P because $H(\cdot)$ is assumed to be increasing. For a given α, a higher value of P will satisfy the equation. ∎

Proof of proposition 4: Let all outsiders with valuations less than K be deterred and the rest takeover the firm and pay K. The market value of the firm is then

$$K(1 - F(K))$$

which is maximized at K^* such that $K^*H(K^*) = 1$ and the market value is increasing in K for all $K < K^*$.

In equilibrium the blockholder chooses P(v_b) such that $(P(v_b) - v_b)H(P(v_b)) = \alpha$. At $v_b = K^*$ and $\alpha = 0$ the blockholder chooses to deter up to $P = K^*$ which is the optimal level of deterrence. For $\alpha > 0$, the blockholder will deter to a $P > K^*$ and, thus, any $\alpha > 0$ will reduce firm value.

For $v_b < K^*$ and $\alpha = 0$ the blockholder chooses to deter up to v_b which is less than K^*. An increase in α strictly increases P(v_b) (proposition 3) and thus increases firm value up to the point where P(v_b) is equal to K^*. This limiting value of α is labelled as $\hat{\alpha}$

If $v_b = 0$, then the blockholder chooses to deter up to $P\,H(P) = \alpha$. α less than 1 implies

$P(0) < K^*$ for all α, that is $\hat{\alpha} = 1$. ∎

Proof of proposition 5: All outsiders in a robust equilibrium with P(v_b=0) will not bid but the blockholder will have to contest the bids of outsiders with valuations above P(v_b=0). As P(v_b) is greater than v_b, for all outsiders' value realizations between v_b and P(v_b) the blockholder will end up winning the contest and paying v_o, which is higher than v_b. As Prob[$v_b < v_o < P(v_b)$] is strictly positive, the blockholder will overpay with strictly positive probability. ∎

Proof of proposition 6

First Price auction The valuations of the blockholders is v_1 and v_2, which are i.i.d. uniform [0,1] respectively. Let the bidding functions be $b_i(v_i)$ and let the inverse bidding functions be $h_i(b) \equiv b_i^{-1}(v_i)$.

Expected profit of bidder 1 is

$$\begin{aligned}
\Pi(b, v_1) &= \int_0^{h_2(b)} (v_1 - (1-\alpha)b)dv_2 + \alpha \int_{h_2(b)}^1 b_2(v_2)dv_2 \\
&= (v_1 - (1-\alpha)b)h_2(b) + \alpha \int_{h_2(b)}^1 b_2(v_2)dv_2 \\
\text{F.O.C.} \Rightarrow & \\
\frac{\partial \Pi(\cdot)}{\partial b} &= (v_1 - (1-\alpha)b)h_2'(b) - (1-\alpha)h_2(b) - \alpha b h_2'(b) = 0 \\
& (v_1 - b)h_2'(b) - (1-\alpha)h_2(b) = 0
\end{aligned}$$

In equilibrium $v_1 = h_1(b)$, thus

$$h_2'(b) = \frac{(1-\alpha)h_2(b)}{(h_1(b) - b)} \tag{7}$$

Assuming a symmetric equilibrium implies $h_1(\cdot) = h_2(\cdot) = h(\cdot)$. Thus the above first order conditions reduce to:

$$\begin{aligned}
h'(b) &= \frac{(1-\alpha)h(b)}{(h(b) - b)} \\
&= \frac{ch(b)}{(h(b) - b)} \qquad \text{where c=(1-}\alpha\text{)}
\end{aligned}$$

Substitute $u(b) = \frac{h(b)}{b}$ or $h'(b) = u'(b)b + u(b)$.

$$u'b + u = \frac{cub}{ub - b}$$

$$
\begin{aligned}
u'b + u &= \frac{cu}{u-1} \\
u'b &= \frac{cu - u(u-1)}{u-1} \\
\frac{(u-1)}{u(c+1) - u^2} u' &= \frac{1}{b} \\
-\frac{1}{u\,(c+1)} - \frac{c}{(c+1)\,(-c-1+u)} &= \frac{1}{b} \\
\text{Integrating both sides:} & \\
ln(u) + ln(u-c-1)^c &= ln(b)^{-(c+1)} + ln(K) \\
u(u-c-1)^c &= b^{-(c+1)} K \\
\frac{h}{b}(\frac{h}{b} - c - 1)^c &= b^{-(c+1)} K \\
\frac{h}{b}(\frac{h - bc - b}{b})^c &= b^{-(c+1)} K \\
h(h - bc - b)^c &= K
\end{aligned}
$$

Applying BC h(0)=0 we get K=0. Thus the solution of the differential equation is either $h \equiv 0$ or

$$h = b(c+1) = b(2-\alpha)$$

or equivalently:

$$b_{fp} = \frac{v}{2-\alpha}$$

The expected revenue from the auction can be calculated as follows:

$$
\begin{aligned}
\text{Expected Revenue (FP)} &= 2 * \int_{v_1=0}^{1} \left(\int_{v_2=0}^{v_1} \frac{v_1 dv_2}{2-\alpha} \right) dv_1 \\
&= \frac{2}{2-\alpha} \int_0^1 v_1^2 dv_1 \\
&= \left(\frac{2}{2-\alpha} \right) \frac{1}{3} \qquad (8)
\end{aligned}
$$

Progressive Bid Auction Let $l_i(v)$ (for i=1,2) be the bidding functions of the two blockholders. That is the blockholders will bid up to $l_i(v)$.

The expected profit of bidder 1 of bidding b conditional on value realization v_1 is given by,

$$
\begin{aligned}
E.P.(b) &= \int_{v_2=0}^{l_2^{-1}(b)} [v_1 - (1-\alpha_1) l_2(v_2)]\, dv_2 + \alpha_1 b \int_{l_2^{-1}(b)}^{\overline{v}} dv_2 \\
&= \int_{v_2=0}^{l_2^{-1}(b)} [v_1 - (1-\alpha_1) l_2(v_2)]\, dv_2 + \alpha_1 b [1 - l_2^{-1}(b)]
\end{aligned}
$$

Define, $l_i^{-1}(\cdot)$ as $m_i(\cdot)$. The f.o.c. w.r.t. to b, give

$$[v_1 - (1-\alpha_1)b]m_2'(b) + \alpha_1[1 - m_2(b)] - \alpha_1 b m_2'(b) = 0$$

the above simplifies to,

$$[v_1 - b]m_2'(b) + \alpha_1[1 - m_2(b)] = 0$$
$$\text{or } v_1 = b - \frac{\alpha_1[1 - m_2(b)]}{m_2'(b)}$$

Assuming that the bidding function is increasing in v, the above equation shows that the valuation of the blockholder will always be less than his or her bid. Thus there will always exist instances when the blockholder will end up making a loss.

In equilibrium $v_1 = m_1(b)$ and $v_2 = m_2(b)$. Substituting in above and by using symmetry, we get

$$\begin{aligned}(m_1(b) - b)m_2'(b) + \alpha_1[1 - m_2(b)] &= 0\\ (m_2(b) - b)m_1'(b) + \alpha_2[1 - m_1(b)] &= 0\end{aligned}$$

In a symmetric equilibrium $\alpha_1 = \alpha_2 = \alpha$ and $m_1(b) = m_2(b) = m(b)$ for every b. Thus,

$$m'(b) = \frac{\alpha[1 - m(b)]}{b - m(b)}$$

The solution to the above differential equations will give us the solution to the bidding strategies of the blockholders. The inverse bidding function

$$m(b) = (1+\alpha)b - \alpha$$

solves the above differential equation. The corresponding bidding functions are

$$l_1(v) = l_2(v) = \frac{v+\alpha}{1+\alpha}$$

Notice that the bidding function in the single blockholder case is exactly the same. The expected revenue to the firm can be calculated to be

$$\begin{aligned}\text{Expected Revenue (SP)} &= 2 * \int_{v_1=0}^{1} \left(\int_{v_2=0}^{v_1} \frac{v+\alpha}{1+\alpha} dv_2 \right) dv_1\\ &= \left(\frac{1+3\alpha}{1+\alpha}\right)\frac{1}{3} \qquad (9)\end{aligned}$$

Comparing the expected revenues for the two auction procedures (equations 8 and 9) it can be easily shown that the expected revenue in the progressive bid auction is higher than that in the first price auction for all α less than 1. ∎

Proof of Proposition 7: In a robust equilibrium outsider's will start bidding below P(v_b=0). For initial bid premia to exist all we need to show is that the market price will be less than P(v_b=0). The market price is given by the expectation of the price obtained in a takeover contest times the probability of the target being discovered. If the blockholder is committed to deter up to P then

$$v_m = \pi\,[F(P) * 0 + (1 - F(P))\,Min[P, v_o]]$$

v_m approaches 0 (normalization of current value) as π goes to zero. Thus for π small enough the initial bid will be at a premium to the market value. ∎

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