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Chapter 26

Mergers and Acquisitions: Strategic and Informational Issues

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1. Introduction

A merger is a transaction that combines two firms, leaving one surviving entity. An acquisition is the purchase of one firm by another individual or firm. Both transactions fall under the more general heading of *takeovers*. Takeovers can play a constructive economic role, for example by removing inefficient management or by achieving economies of scale and complementarity. On the other hand, they can have the possibly less desirable effect of redistributing wealth, as in takeovers that exploit tax benefits or expropriate bondholders or stakeholders. Finally, takeovers may reduce efficiency if they reflect agency problems on the part of bidding managers, or result simply from misjudgments.

There are many important conflicts of interest and informational differences among parties to takeovers: bidding shareholders who only want an acquisition if the price of the target is not too high compared to underlying value, bidding management who may seek self-aggrandization through takeover, target shareholders who wish to obtain a price that fully reflects any possible takeover improvements, target management who wish to retain private benefits of control, and potential competing bidders deciding whether to make their own offers.

This essay describes the relationships between different models of the takeover process, and where possible provides analytical syntheses to integrate major trends in the literature. I focus mainly on three types of models: (1) models of tender offers, which examine the decisions of individual shareholders whether to tender (sell) their shares to a bidder, (2) models of competition among multiple bidders, and (3) models that examine the voting power of target managers who own shares.[1]

Beginning with (1), tender offers to purchase shares directly from shareholders are a crucial mechanism for overcoming management opposition to takeover,

[1] These categories are neither mutually exclusive nor exhaustive. In practice, however, most theoretical papers on takeovers have fallen into one of these categories. Many of the insights from these papers would also apply to other cases, such as the analysis of merger bid when there is little competitive threat, or the analysis of tender offers when there is competitive threat.

as contrasted with merger bids which require management approval. Models of the tender offer process may be classified according to whether (i) all parties are identically informed, or alternatively the bidder has superior information about the post-takeover value of the target; and whether (ii) individual target shareholders take the probability of offer success as given, or else recognize the influence of their individual tendering decisions upon offer success or failure.

Issues (i) and (ii) are important for understanding target managers' defensive measures and bidders' incentives to undertake mergers and acquisitions, and so for the design of regulatory policy. With regard to (i), superior bidder information presents target shareholders with an inference problem. One would expect that this informational disadvantage could lead target shareholders to be skeptical about the adequacy of the offer, and thus reluctant to tender their shares. I therefore examine the effect of bidder information on its probability of success and expected profits, and how defensive measures affect the informational advantage.

With regard to (ii), if target shareholders take probability of success as given, then their tendering decisions will be nonstrategic — being based on a simple comparison of gains from tendering or not. If a shareholder's decision influences the probability of success, however, she has a stronger incentive to tender in order to bring about success. This essay will therefore examine the determinants of how likely it is that individual shareholders will be pivotal in determining offer success, and the effect of this probability on the expected profitability of takeovers for bidders.

Turning to point (2), models of competition, any attempt to understand competitive takeover auctions must address the anomaly that bidding in takeover contests generally occurs in a few large jumps, rather than many small increments as predicted by the conventional analysis of bidding in costless English auctions. This essay therefore examines models of costly investigation and costly bid revision, wherein successive bids may increase by large increments when bidders try to intimidate their competitors into quitting. Since the intimidated bidder may be able to increase value more than the intimidator, this may not be a good thing. This leads to consideration of the effects of regulations that influence the cost of investigation and the ease of preemption. I will also consider how the choice of means of payment (cash, equity, or other securities) can signal information, and thus can be used as a tool for preempting competitors.

Finally, with regard to point (3) above, the share ownership and voting power of target management that values control can be important for the outcome of a tender bid and for the bidder's decision whether to undertake a tender offer or a proxy fight. It is therefore important to understand how a manager may be able to alter his effective control of voting rights either directly through share purchases or indirectly through changes in capital structure.

This essay mainly covers topics that have been the focus of several related models that yield divergent results. It is for these topics that integrated discussion and analysis seems most valuable and feasible. The cost of this approach is that many other important topics are not addressed here or are only briefly touched upon. Such topics include the analysis of why takeover occur, bidder/target bargaining, the effect on competition of bidding by well-informed target managers (as in leveraged buyouts), winner's curse effects when bidders with common valuations compete, and the effect of takeover threats on directorial oversight of managers and on investment and operating decisions. Section 7 discusses these issues briefly and gives some literature references.

The remainder of this essay is structured as follows. Section 2 gives a synopsis of empirical material. Section 3 discusses tender offers and share tendering decisions. Section 4 analyzes competitive bidding. Section 5 discusses the means of payment in takeover contests. Section 6 discusses target financing, managerial voting power and private benefits of control. Section 8 concludes.

2. An empirical synopsis

This section lays out some empirical evidence relevant for the theories discussed in this review. The summary will by no means be comprehensive, even for this limited purpose.

Target shareholders on average earn large positive abnormal returns from tender offers, while bidding shareholder abnormal returns are on average close to zero; see, e.g., Weston, Chung & Hoag [1990] for summary of empirical evidence. High target returns reflect remarkably high and rising premia in successful contests. Nathan & O'Keefe [1989] report average successful premia for cash tender takeovers that rose from 41% to 75% in the 1963–1973 and 1974–1985 periods, and a rise from rose from 29% to 70% for cash merger premia.

The Williams Act of 1968 and associated legislation requires disclosure and delays completion of tender offers. Tender offer premia decreased after the Williams Act [Nathan & O'Keefe, 1989].[2]

Bradley, Desai & Kim [1988] provide evidence that the joint market value increase of bidder and target is on average positive. Bradley, Desai & Kim [1983] find that target stock market gains on average vanish in failed offers where the target is not later acquired by another bidder. Roll [1986] emphasized that stock returns may not accurately measure value improvements to the extent that making a takeover bid reveals information about the stand-alone value of the bidder (e.g., that the bidder has enough funds to afford the offer). However, Bhagat & Hirshleifer [1995] estimate value improvements to be on average positive and substantial using a method that disentangles value improvements from revelation effects.

Bradley, Desai & Kim [1988] also find that U.S. bidder abnormal stock returns were on average lower in the 1980s than in the 1960s and 1970s. They report that multiple bidder contests provide higher average abnormal target stock returns, and lower bidder returns (close to zero).

[2] A persistent upward trend in takeover premia and target abnormal returns began five years after the Williams Act. This timing suggests that the change was not related to the Williams Act. A similar increase occurred in the UK [Franks & Harris, 1989] during the 1970s and 80s.

Tender offer success versus failure is often highly uncertain, as evidenced by the negative reaction of the target stock price to offer failure [see Bradley, Desai & Kim, 1983; Samuelson & Rosenthal, 1986; Ruback, 1988] and by the positive bidder stock price reaction to success and negative reaction to failure [see Bradley, 1980]. Offer success is positively related to the bid premium and to the initial shareholding of the bidder in the target [Walkling, 1985].

Target management defensive measures on average reduce the probability of a takeover occurring [Walkling, 1985; Pound, 1988]. The target stock price reaction to greenmail is on average negative [Bradley & Wakeman, 1983; and Dann & DeAngelo, 1983], as is the average reaction to antitakeover amendments, poison pills, defensive restructurings, and several other defensive measures [see, e.g., Bhagat & Jefferis, 1991; Malatesta & Walkling, 1988; Ryngaert, 1988; and Dann & DeAngelo, 1988].

There is evidence that target managers can position their firms in ways that alter bidder behavior. Stulz, Walkling & Song [1990] provide evidence that the bid level is on average higher when target management owns a greater share of the target. Palepu [1986] finds that the probability of a hostile takeover attempt is decreasing with the target's debt–equity ratio.

Certain items of evidence have provided sharp empirical challenges to theories of the takeover transaction process. The traditional solution to the English auctions model with multiple buyers involves many small bid increments. This has faced a glaring challenge from the evidence that takeover bidding occurs by small numbers of enormous jumps, a challenge taken up in Section 4. In Jennings & Mazzeo [1993] the majority of *initial* bid premia were over 20% of the market value of the target 10 days prior to the offer. Since price runup may occur earlier, this is likely to be an underestimate of premia relative to non-takeover value.

A second challenge is provided by the often puzzlingly low ownership in target firms accumulated by bidders prior to making a takeover bid. Given the very high premia paid in tender offers, we would expect bidders to buy up shares at the open market price prior to the bid up to the limits of market liquidity. In fact, the majority of tender offer bidders own no target shares [Bradley, Desai & Kim, 1988],[3] and even among those that do, the potential profit on these holdings appears to be modest compared to bidding costs [Bhagat & Hirshleifer, 1995]. This challenge is taken up by theories discussed in Section 3.1.5.

A third empirical challenge is the mixed evidence regarding the effect of means of payment (stock versus fixed payments) on bidder and target stock abnormal stock returns. There is evidence, consistent with the Myers & Majluf [1984] adverse selection problem with equity issuance, that bidder and target returns for stock offers are on average lower than for cash offers (see, e.g., Huang & Walkling [1987] on target returns). However, the U.S. result that average abnormal bidder returns are negative in stock offers does not apply in France, the UK or Canada

[3] In a sample of successful post-1968 offers, Stulz, Walkling & Song [1990] find a positive median bidder share ownership of 2.35% among successful offers, and a 4.75% ownership in successful single bidder contests.

(Eckbo, Giammarino & Heinkel [1990] and citations therein). Furthermore, Lang, Stulz & Walkling [1991] report that the effect of means of payment in the U.S. is subsumed by a cash flow variable. The associated theoretical issues are discussed in Section 5.

3. Tender offers and share tendering decisions

A tender offer can be either conditional or unconditional. A conditional offer is not binding on the bidder unless a given number of shares are tendered. An offer may require acceptance of all tendered shares (an unrestricted offer), or alternatively the bidder may not be obliged to purchase more than a prespecified number of shares (a restricted offer). An offer that is unconditional and unrestricted is often called an 'any-or-all' offer.

Consider a bidder who can increase the value of the target only if he obtains control. Except where otherwise specified, in this essay the non-takeover value of the target firm is normalized to zero. Also, I assume that the bidder obtains no control unless he succeeds in buying a given fraction of target shares, in which event he obtains complete control. Let v be the post-takeover value of a firm's shares. Ignoring taxes, a risk-neutral target shareholder i should tender if the price offered for the firm's shares, b, exceeds the expected value of her share if she retains it:

$$\text{Tender if } b > \Pr(\text{Success} \mid i \text{ Retain})v. \tag{1}$$

A target shareholder will be more willing to tender if she believes that post-takeover value v is low, and if she believes that her individual decision not to tender will reduce the takeover's probability of succeeding.

Section 3.1 presents a model (due to Grossman & Hart [1980], Shleifer & Vishny [1986a], and Hirshleifer & Titman [1990]) in which each shareholder believes he will not be pivotal. This model allows for possible informational superiority of the bidder. Section 3.2 discusses models (by Bagnoli & Lipman [1988] and Holmstrom & Nalebuff [1992]) which allow for the fact that individual shareholders are sometimes pivotal, but assume symmetric information.

3.1. *A nonpivotal shareholder model*

3.1.1. *The model under complete information*

Consider a bidder who can increase the value of the target to \$100 per share if he obtains control, which requires >50% of the target's shares. Assume the offer is conditional upon obtaining control. Under some circumstances, he will be unable to profit on the shares that he purchases owing to a free-rider problem among target shareholders [Grossman & Hart, 1980; Bradley, 1980]. Suppose he makes a rather generous offer of \$80 per share. Each shareholder reasons that if the offer fails, the value of her retained shares remains the same regardless of whether she tenders; while if the offer succeeds, she is better off receiving the post-takeover value of \$100 than the offered price of \$80. Thus each shareholder will retain her shares, and the offer will fail, even though its success would be jointly profitable for shareholders. The paradoxical conclusion is that a bidder cannot succeed in a tender offer except at a price that gives all the potential profits to the target shareholders. If there is any cost of investigation or bidding, the bidder actually loses money. Empirically, the evidence cited earlier on bidder and target stock returns are fairly consistent with this conclusion, particularly in the 1980s.

Nevertheless, bidders may reap a profit if they can dilute the value of minority shares after a takeover (Grossman and Hart).[4] The threat of dilution may induce target shareholders to tender at a price low enough for the bidder to profit. Alternatively, if the bidder himself owns shares in the target prior to the offer, he can reap a profit even without dilution. By improving firm value, he increases the value of his own shares [Shleifer & Vishny, 1986a].[5]

To illustrate these points, let the post-takeover value of the target be v, the fraction that can be diluted be δ, the initial fractional shareholding of the bidder in the target be α, the level of the conditional tender offer be b, and the cost of bidding be c^{B}.[6] Under complete information, a risk neutral target shareholder will tender if the price offered exceeds the diluted post-takeover value, i.e.:

$$\text{Tender if } b > (1-\delta)v. \tag{2}$$

Assume that the bidder needs to buy an additional fraction of at least ω of the firm's shares, over and above his initial fraction α, to obtain control. The equilibrium strategy pair for the bidder is to offer just above $(1-\delta)v$, and for all shareholders to tender at this price. If the offer is unrestricted (so that all tendered shares are purchased), he therefore purchases all $1-\alpha$ shares, for a profit of

$$\alpha v + (1-\alpha)(v-b) - c^{\mathrm{B}}. \tag{3}$$

Combining (2) with (3) gives the following proposition.

Proposition 1. *Under complete information, the bidder's profit in a conditional unrestricted offer is*

$$\alpha v + (1-\alpha)\delta v - c^{\mathrm{B}}.$$

[4] In other words, the bidder can exclude (nontendering) minority target shareholders from part of the post-takeover value of the target firm. For example, the bidder, having obtained control, may be able to choose the price in a merger with the target (subject to legal constraints). Or the bidder may be able to buy assets of the target at a below-market price. A restricted two-tier offer can be profitable if nontendering minority shareholders can be forced to accept less than tendering shareholders. This will be the case if there is a credible dilution threat.

[5] Since this internalizes only a fraction of the value improvement, the bidder still has a suboptimal incentive to make a bid.

[6] Since the non-takeover value has been set to zero, the possibility that the bidder can extract value from the target's assets-in-place (rather than just appropriating part of the takeover improvement) has been excluded.

The first term is the improvement in value of the bidder's initial shareholding. The second term is the profit on the shares purchased in the tender offer. If follows trivially (letting α and δ approach zero) that:

Proposition 2. *Under complete information, if a bidder's initial shareholding (α) in the target and dilution opportunities (δ) are sufficiently small, then a conditional unrestricted tender offer is unprofitable.*

Four further points are worth noting. First, diluting target value may be costly, in the sense that the bidder's gain is less than target shareholder's loss. If so, then it is a dominant strategy for the bidder to make an unrestricted offer as assumed above.[7] Second, the second term in Proposition 1 shows that having an initial shareholding reduces the value of the dilution threat, because to some extent the bidder would be diluting his own holdings. Third, the profit deriving from initial shareholdings tends to be fairly small because of low shareholdings (see empirical synopsis). Fourth, if a shareholder may be pivotal, or if the offer is unconditional, then a threat by the bidder to reduce the target's *non*-takeover value would also encourage shareholders to tender.[8]

3.1.2. Share tendering decisions under asymmetric information

A bidder usually knows what he plans to do with the target better than target shareholders. Superficially, it might appear that a bidder could on average profit even without dilution or an initial shareholding, based on superior information about the post-takeover value of the target (v). However, rational expectations (or in game-theoretic terminology, perfect Bayesian equilibrium) implies that if the bidders were on average offering less than post-takeover value in tender offers, shareholders would be aware of this and would refuse to tender. Thus, the free-rider problem remains when asymmetric information is introduced.

In such a generalized model, two equilibria are of interest. In one, the price offered is uninformative, and offers always succeed [Shleifer & Vishny, 1986a]. In the other, the level of the offer reveals the bidder's valuation, and the probability of offer success increases with the amount offered [Hirshleifer & Titman, 1990].[9]

3.1.2.1. Uninformative offer levels. If a bidder's information about post-takeover value or about potential dilution is superior to that of target shareholders, then shareholders must draw some inference about the bidder's valuation from the level of the offer. Shleifer & Vishny [1986a] provide a model in which the level of

[7] If there is no wastage, then whether the offer is restricted is a matter of indifference. Even if wastage is arbitrarily close to 100%, as Proposition 1 shows, the bidder benefits substantially from the threat of dilution since it allows him to buy shares cheaply.

[8] Gilbert & Newbery [1988] examine a model in which a bidder acquires cheaply because he can threaten to enter an industry and reduce the profits of a member of an oligopoly.

[9] In what follows, it is assumed that the only information asymmetry is about post-takeover value v; information is symmetric about the initial shareholding α. Regulations require the bidder to file information about share ownership with the S.E.C. at the time of the bid.

the offer is uninformative in equilibrium, because shareholders foresee perfectly the price that will be offered if a bid occurs. Since it is assumed that at any offer level the bidder knows with certainty whether shareholders will tender, the equilibrium price offered is set to be just high enough to induce shareholders to accept the offer. When indifferent, it is assumed that target shareholders tender. For simplicity, assume that there is no dilution ($\delta = 0$), that bidding is costless ($c^{\mathrm{B}} = 0$), and that (possibly owing to financing costs) the offer is restricted to the minimum additional fraction of the firms shares needed for control, ω.

Then to persuade target shareholders to tender, a bidder must offer target shareholders at least

$$b^* = E[v \mid \text{Offer}], \tag{4}$$

where the RHS is the expected valuation of the bidder given that he makes an offer. In the proposed equilibrium, a bidder with low valuation cannot reduce the amount offered, because if he bid any less, $b < b^*$, shareholders would infer that his valuation was higher than the amount offered, $v > b$, and so would retain their shares. Thus, the probability of success $P(b)$ is a step function of the level of the offer, i.e., $P(b) = 0$ if $b < E[v]$, and $P(b) = 1$ if $b \geq E[v]$ (as illustrated by the dark line segments in Figure 1).

Proposition 3. *Under asymmetric information, there is an equilibrium in which a bidder who makes an offer pays a price equal to the expected post-takeover valuation of the shares he purchases. His gain on the shares he buys is positive if the improvement v is high, and is negative if v is low. He derives an expected profit from the increase in value of his initial shareholding in the target.*

On average a bidder does not profit on the shares purchased in a tender offer. (If he did, shareholders would not want to tender!) A bidder with valuation v close to zero will not make an offer, because he takes a loss on the shares purchased in the offer of $v - b^*$, and his initial holding profit αv is low. For larger v, the bidder's profits both on shares purchased and on the initial holding increase. There is a critical value v^* such that profits are zero. The bidder makes an offer if and only if $v > v^*$. Thus, the bid in (4) is $b^* = E[v \mid v > v^*]$.[10]

3.1.2.2. Revealing offer levels. The bidder's gain from succeeding is increasing with its valuation of the target. Since a low offer reduces the probability of offer success [Walkling, 1985], a low-valuation bidder has a stronger incentive to save money by defecting to a low offer than a high-valuation bidder.[11] The probability

[10] If bidding is costly, the critical value increases. An empirical implication is that if the cost of bidding decreases, the critical level for bidding decreases, so premia on average decrease.

[11] A low-valuation bidder who makes a lower bid will profit under a wider set of shareholder responses than a high-valuation bidder. This suggests that investors should believe his valuation is low, and should accept his offer. Thus, the pooling equilibrium of the preceding section is removed by the strong refinement criterion of Banks & Sobel [1987]. However, the pooling equilibrium survives several other criteria, such as those of Grossman & Perry [1986] and Cho & Kreps [1987].

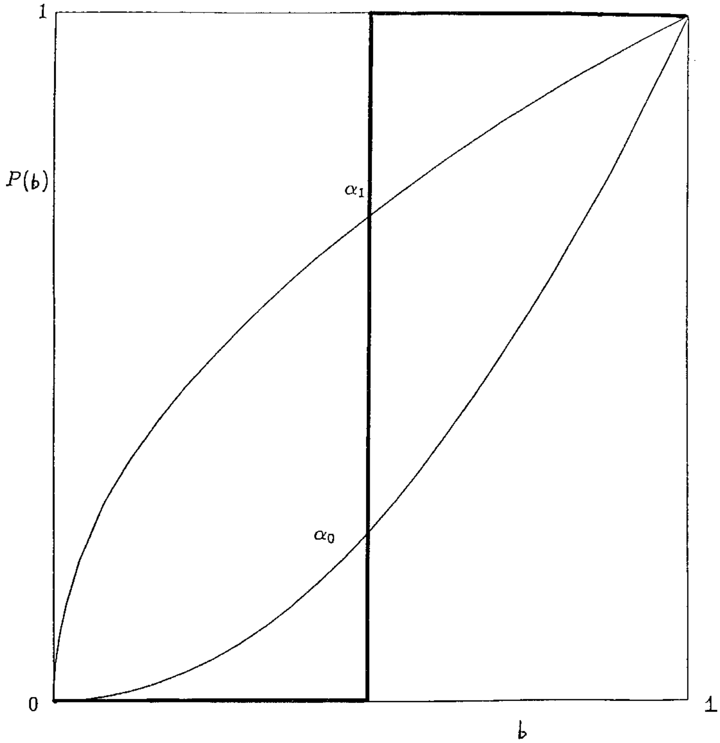

Fig. 1.

of a low offer succeeding is greater to the extent that the bidder can persuade shareholders that his improvement is small, since this encourages shareholders to tender [equation (1)]. Since high-valuation bidders have a stronger incentive to bid high, a bidder can reveal a lower valuation credibly by bidding less.

In order to examine the revealing equilibrium of the tender offer model, let $P(b; \alpha, \omega)$ be an offer's probability of success given a bid of b by a bidder with initial shareholding of α who needs a further ω shares to obtain control. The bidder chooses a bid level to maximize his expected profit, so he solves

$$\max_b \, [\alpha v + (v - b)\omega] P(b;\, \alpha, \omega). \tag{5}$$

The first order condition for this problem is

$$P'(b)[\alpha v + (v - b)\omega] = P(b)\omega. \tag{6}$$

Assuming an interior solution for b, and parametrically differentiating (6) with respect to v, implies the following proposition [see Hirshleifer & Titman, 1990].

Proposition 4. *Suppose that a bidder faces an exogenous probability of offer success function that is twice differentiable and increasing with the amount bid. If an interior* *optimal level of the bid exists for each bidder valuation, then the level of the bid is increasing in the bidder's valuation of the target* ($\mathrm{d}b/\mathrm{d}v > 0$). *Therefore, the bidder's information is fully revealed by his bid.*

This proposition takes shareholder behavior as exogenous, so we cannot yet conclude that there is a revealing equilibrium. One is displayed later. Proposition 4, however, shows that almost any reasonable model of tender offers will lead to separation for at least a range of bidder types. For example, in a model in which target management can take defensive action but cannot with perfect effectiveness 'just say no', we expect the intensity of opposition to the takeover to decrease with the amount bid, so the probability of offer success should increase smoothly. Such a model leads to full revelation. A steadily increasing probability of success as a function of the bid can also be derived from a model where shareholders have different capital gains bases [Stulz, 1988; Bagwell, 1991].[12] In the pooling equilibrium of the previous section, there is no revelation because it violates the assumption of a continuous probability of success.

In the model developed here, there is a unique equilibrium in which the level of the bid is a fully revealing signal of the bidder's valuation. In this equilibrium, the bidder offers his valuation, the minimum amounted needed to have a chance of succeeding, $b = v$ [compare with equation (4)]. Instead of assuming that indifferent shareholders always tender, let us now (consistent with evidence cited earlier) allow for the possibility that the outcome of the offer is uncertain from the viewpoint of the bidder. This uncertainty is modelled as arising from randomization by shareholders as to whether to tender in a mixed strategy equilibrium.[13] In the mixed strategy equilibrium, the bidder's uncertainty about his probability of success at different bid levels is such that he optimally makes a bid that leaves shareholders indifferent as to whether to tender. Imposing the indifference condition ($b = v$) in (6) leads to a differential equation that determines the probability of success,

$$\frac{P'(b)}{P(b)} = \frac{\omega}{\alpha b}. \tag{7}$$

The relevant boundary condition is that the highest possible bid (made by the highest valuation bidder) always succeeds, $P(\bar{v}) = 1$. The solution,

$$P(b; \alpha) = \left(\frac{b}{\bar{v}}\right)^{\omega/\alpha}, \tag{8}$$

is illustrated by the dark curves in Figure 1. The probability of an offer's success increases with the bid premium and with the initial holding α (consistent with

[12] Pooling among the highest valuation types, however, remains a possibility because if a very high offer is sure to succeed, above this bid level $P(b)$ is no longer increasing.

[13] A mixed strategy equilibrium is a way of modeling the fact that, owing to small amounts of uncertainty about payoffs, the behavior of some players (target shareholders) seems uncertain from the point of view of another player (the bidder) [see Harsanyi, 1973]. For example, the bidder may not know the liquidity or capital gains tax considerations that affect shareholders' tender decisions.

evidence cited earlier) of Walkling [1985], and decreases with the number of additional shares needed for control ω.[14] Offer failure is caused by the informational superiority of the bidder. Shareholders recognize the bidder's temptation to offer less than the post-takeover value of their shares, and are therefore reluctant to tender at low prices (i.e., they tender with lower probability). The model therefore predicts that actions that improve the information of target shareholders will (by shifting the upper bound $\bar{v}$ in (8) downward toward the true value $v < \bar{v}$) increase the probability of offer success.[15]

Like an initial shareholding, proportional dilution increases the benefit to achieving success. It therefore increases the incentive to bid high. This reduces shareholders' skepticism of the offer, and increases the probability of offer success.[16]

This model assumes that if the offer fails, the bidder does not acquire the target and hence loses a valuable profit opportunity. In reality, if an offer fails, the bidder can revise his offer upward. This opportunity can potentially eliminate the separating equilibrium. In order for a separating equilibrium to survive, it is crucial that failure impose an opportunity cost on the bidder that is increasing in the size of the potential value improvement. This can occur for several reasons: (1) initial failure gives entrenched managers more time to mobilize blocking defensive strategies, (2) failure may give target management time to announce changes that preempt the potential takeover improvement, (3) loss of time can involve the loss of a window of opportunity to exploit a synergy between the firms, and (4) rejection may give a competing bidder time to enter. The arrival of a competitor is costly to a bidder who hopes to profit by diluting minority shareholders [see Hirshleifer & Titman, 1990, section I.D]. In evaluating defensive measures in the next section, it should be kept in mind that the efficiency consequences of failure of an initial offer depend on which of the costs of failure listed above are relevant.

3.1.3. Management defensive strategies

We focus in this section on the revealing equilibrium, since it permits analysis of how defensive strategies affect the information revealed by the bid and the probability of offer success.

[14] Thus, a supermajority antitakeover amendment reduces the probability of offer success. An untested implication of the model is that the ratio of the target stock price increase at the announcement of the bid to the bid premium is increasing in both the bid level and α, and decreasing in ω. The model also implies that average premia are lower when the initial shareholding α is higher (consistent with evidence of Walkling & Edmister [1985]), and when the required number of shares ω is lower.

[15] This is consistent with Walkling's [1985] evidence that share solicitation activity increases the probability of success.

[16] Asquith [1991] extends this model by allowing for a probability that the bidding manager is afflicted with 'hubris' [see Roll, 1986] in the sense that he incorrectly believes he can increase target value (i.e., he believes that $v > 0$ when actually $v = 0$). Asquith shows that the presence of hubristic bidders allows nonhubristic bidders to profit, even without dilution and without initial shareholdings. Target shareholders become willing to tender even if rational bidders offer below post-takeover value owing to the chance that the offer is from a hubristic bidder. Thus hubris can improve efficiency despite the obvious cost of inefficient takeovers.

3.1.3.1. Effects on incentive to bid high. A manager who values control may oppose takeover for his own purposes. As an extreme example, if a target manager is expected to be able to block any reasonable offer, then no offer will be made. The Grossman & Hart model without dilution (Section 3.1.1) suggests that defensive measures are undesirable, as there is already too little incentive to make an offer. They suggest that target shareholders, in order to attract later takeovers, will write corporate charters that encourage dilution, e.g., the absence of defensive antitakeover provisions such as 'fair price' amendments or classified boards [see Jarrell & Poulsen, 1987]. However, the incentive of target shareholders to permit dilution is too weak, because extracting a high price from the bidder provides shareholders with a redistributive gain.

On the other hand, if a bidder has substantial opportunities for dilution, then target shareholders can benefit from defensive activity to force a higher bid [DeAngelo & Rice, 1983]. There is a time-inconsistency problem here, however, in that the ex-post benefit to shareholders of forcing a higher price conflicts with the ex-ante benefit of encouraging potential bidders to investigate the target.

In practice, U.S. courts have allowed firms to reject takeover offers at will based upon the 'business judgement' of target management. Target management's incentive to block low-priced offers is greater when management's share ownership is high. The key exception in which the target management may be coerced into selling is if it has already begun negotiating sale of the firm to another buyer. Once the firm has been put in play in this fashion, management is obligated to auction the firm and attempt to get the best deal for shareholders.

Since a defensive measure can induce a high offer, when information is asymmetric defensive measures can reduce shareholders' skepticism, and thereby increase the probability of offer success. Consider a threat to block the offer unless an offer of over $\bar{v}$ is made. Since the bidder must then offer $b > \bar{v}$, shareholders should always tender, and the offer will always succeed. More generally, if the cost or risk of failure imposed on the bidder by the defensive strategy is greater when the bid is lower, then the bidder is encouraged to bid higher, so that shareholders probabilistically become more willing to tender [Hirshleifer & Titman, 1990].

These results are summarized as follows.

Proposition 5. *A management defensive strategy, by blocking takeover, can harm target shareholders and reduce efficiency. However, by increasing the incentive to bid high, such a measure can also increase the probability of offer success and improve efficiency.*

Other defensive measures reduce the incentive to bid high, and therefore reduce the probability of success. A poison pill, by increasing the value of nontendered shares after a successful offer, acts as the opposite of dilution (see Section 3.1.1 earlier). Thus, it reduces the incentive to ensure success by bidding high. More generally, strategies that impose greater costs on the bidder when his offer succeeds than when it fails reduce the incentive to bid high, since they reduce the gain from success. For example, an antitakeover amendment ('shark repellent') such as staggered board terms that delays transfer of control to the bidder in the event of offer success will reduce bid levels, and so the probability of success. Evidence cited earlier indicating that defensive measures tend to prevent takeover from occurring [Walkling, 1985; Pound, 1988] suggests that target managers may often be acting against shareholder interest by adopting those strategies that prevent takeovers.

3.1.3.2. Effects on asymmetry of information. A subtler effect of defensive strategies is to change the informational advantage of the bidder over target shareholders. Consider a value-reduction strategy, defined as a defensive activity that reduces the post-takeover value of the target. An example would be the sale of an asset that, as part of the target, could be improved by the bidder ('sale of the crown jewels', also known as the 'scorched earth defense'.). A value-reducing defensive measure can reduce or increase informational asymmetry. Suppose that the bidder can increase the value of the target by $v = x + y$, where x is an improvement that is known to shareholders perfectly while y is known to the bidder but not the target. If a value-reduction strategy eliminates the possibility of the unknown improvement y, then the informational asymmetry is removed, and the bidder can ensure success by offering just above x. Thus, a value-reduction strategy can reduce informational asymmetry and promote success.

Conversely, if a value-reduction strategy eliminates the known improvement x, then the probability of success is

$$P(b; \alpha) = \left(\frac{b}{\bar{y}}\right)^{\omega/\alpha}. \tag{9}$$

The probability of success at any level of the bid b is higher than in (8).[17] However, the probability of success is reduced for a given bidder because he bids less when his valuation is reduced.[18]

Proposition 6. *A value-reduction defensive strategy, by decreasing (increasing) the importance of publicly known improvements relative to improvements known privately by the bidder, can decrease (increase) the probability of tender offer success.*

3.1.4. Target private information

The target as well as the bidder may have private information. If the target is undervalued by the market, then by signalling high value, managers can make shareholders less willing to tender. Increasing leverage and repurchasing shares, actions which can signal high value, are often used defensively. Ofer & Thakor [1987] analyze signalling through repurchase; Bagnoli, Gordon, & Lipman [1989] analyze repurchase signalling as a defensive strategy.

[17] This is not surprising, since a given level of the bid becomes more attractive when compared to a smaller post-takeover value.

[18] Without the value-reduction measure, the probability of a bidder with valuation v succeeding is $(v/\bar{v})^{\omega/\alpha}$. With the defensive measure, the probability is $[(v-x)/(\bar{v}-x)]^{\omega/\alpha}$.

3.1.5. *Pre-tender offer share acquisition*

Prior to announcing his offer, a takeover bidder has private information about an event that will increase the market price of the target's stock. This leads to an incentive to acquire shares of the target quietly at a lower price. Pre-takeover share acquisition is limited by disclosure requirements and by the depth of the market, because in a thin market a large purchase of shares will more quickly reveal the information of an informed trader. Kyle & Vila [1991] point out that if the possibility of a takeover is foreseen, then a potential bidder can profit by either buying shares secretly before making a takeover bid or selling shares short and not making a bid.

In any case, the evidence mentioned in the empirical synopsis that the majority of actual tender offer bidders do not accumulate *any* target shares is puzzling. One explanation has to do with the desire to signal low-valuation to target shareholders. Since a high valuation bidder has an incentive to bid higher (see Section 3.1.2.2), he has a stronger incentive to accumulate shares prior to the offer. But this means that the disclosure of the initial shareholding required at the time of an offer for a U.S. firm reveals the bidder's valuation. It follows that there is an incentive to accumulate fewer shares in order to persuade target shareholders to tender their shares at a lower price [Chowdhry & Jegadeesh, 1994].[19]

3.1.6. *The general free-rider problem*

The free-rider problem has been discussed in the context of conditional tender offers. However, the conclusion that in the absence of dilution and initial holdings the bidder cannot profit holds very generally, so long as target shareholders do not perceive themselves to be pivotal.

Let us define a *tender offer* as an offer to buy shares in which the same prespecified price is offered for all purchased shares, no share is purchased unless it is tendered by the shareholder, and if it is tendered, whether it is purchased is a function of the tendering decisions of all shareholders.[20] Suppose that there are two control states, bidder control and target control, leading to target firm values of v or 0 respectively. The state is determined by whether the critical fraction of shares is tendered.

If a shareholder is virtually never pivotal, then she perceives herself as being in a virtually constant-sum game with the bidder. Shareholders as a whole are in a nonconstant sum game with the bidder, but any individual shareholder partakes of only a vanishingly small fraction of the joint benefit derived from her decision to tender. Thus, any offer that gives the individual shareholder an expected profit will give the bidder an expected loss on purchases from that shareholder.

[19] Another possible explanation for low initial holdings is that the bidder wishes to keep the preoffer share price low, if the legally permissible amount of dilution in a freeze-out merger is constrained by this price [Ravid & Spiegel, 1991].

[20] These conditions hold for both conditional and unconditional offers, for either restricted or unrestricted offers, and for offers in which oversubscription leads to pro-rationing, first-come-first-serve, or to discrimination by the bidder amongst different shareholders in acceptance of shares.

Let the cost of bidding be $c^{\mathrm{B}} > 0$. For brevity and clarity of notation, let it be assumed that shareholders tender all or none of their shares; the result does not depend on this assumption.

Definition. A shareholder is *pivotal* if, given the actions of the other shareholders, her decision of whether to tender determines whether the bidder obtains control.

The word 'pivotal' might seem to suggest that there is always exactly one pivotal shareholder. This is far from the case. For example, if there are three identical shareholders, and if all (or if none) tender, then none of them are pivotal. If one or two tender, then two are pivotal. One might expect that in a very widely held firm with small shareholders, shareholders will be very unlikely to be pivotal because it is unlikely that the number of shares tendered will be close to the borderline. The following result, which is in the spirit of Grossman & Hart [1980], shows that such a situation leads to zero gross profits for a takeover bidder. Net of bidding costs, the bidder's profit becomes negative, so no offer occurs.

Proposition 7. *Holding constant the value improvement v but allowing the distribution of target share ownership to vary, as the probability of any shareholder being pivotal approaches zero the bidder's expected gross profit becomes arbitrarily close to zero.*

Proof. See Appendix

The conclusion of this proposition is not at all surprising given the critical premise that the probability of a shareholder being pivotal is small. This assumption is not valid in all models, as discussed in Section 3.2. If an individual shareholder's decision can cause an offer to succeed when otherwise it will fail or *vice versa*, i.e., if he may be pivotal, then he should tender if the price offered exceeds the expected value of her shares *given that she does not tender*. This latter quantity may be below the expected value given that she does tender. This wedge allows the bidder to make a profit on purchased shares.

3.2. When are shareholders pivotal?

This section discusses the conditions under which pivotality can be important. Section 3.2.1 points out that large shareholdings lead to pivotality. Sections 3.2.2 and 3.2.3 discuss equilibria in which pivotality is important even in widely held firms. Section 3.2.4 examines the effect on bidder profits of the ability to bid repeatedly. In Section 3.2.5, I argue that pivotality in widely held firms may not provide a plausible solution to the free-rider problem.

3.2.1. Block size

The larger the blocks held by target shareholders, the larger the probability of being pivotal, and so the greater the incentive to tender. Since in reality there are large blockholders even in many large firms, this is an important escape from the free-rider problem.[21]

Holmstrom & Nalebuff [1992] point out that the increased probability of offer success resulting from the tender of one share by a blockholder increases the expected value of retaining her other shares. A large blockholder therefore has a greater incentive to tender some of her shares than a small one, leading to an equilibrium that gets close to equalizing the number of nontendered shares by larger stockholders. By tendering only a fraction of her shares, a blockholder partly internalizes the benefit accruing to nontendering shareholders.

3.2.2. Pure strategy equilibria with pivotal shareholders

Under complete information, in either a conditional or an unconditional tender offer, there are many equilibria in which just enough shares are tendered to cause a transfer of control. Consider a conditional tender offer for 20,000 shares in a takeover that will increase value. Consider a set of shareholders whose shares total to exactly 20,000. An equilibrium is for these shareholders to tender all their shares, and for the others to retain their shares. In the equilibrium, If any shareholder were to tender one less share, the offer would fail, reducing the value of her nontendered shares. Thus, a bidder can succeed with a very small premium [Bagnoli & Lipman, 1988], apparently solving the free-rider problem.

Proposition 8. *Under complete information, and in the absence of management defensive measures, in both an unconditional tender offer and a conditional offer for the minimum number of shares required to shift control, there exist strong Nash equilibria in which the bidder offers just above zero and receives exactly enough shares to transfer control. Therefore the bidder can effect any desirable change in the target even if he owns no shares in the target and cannot dilute.*

3.2.3. Mixed strategy equilibria with pivotal shareholders

There are also many mixed strategy equilibria in which shareholders are sometimes pivotal. Continuing the assumption of complete information, let us focus on any-or-all offers. Intuitively, if other shareholders tender with high probability, then the offer is likely to succeed, in which case a given shareholder would do better to retain her shares; while if other shareholders tender with low probability, then the offer is likely to fail, in which case a given shareholder does better by tendering. Thus, there is a stable outcome in which shareholders tender with intermediate probability (see Bagnoli & Lipman, 1988; Holmstrom & Nalebuff, 1992].[22]

[21] This is related to the general principle, important in the theory of political pressure groups, that the small free-ride on the large [see Olson, 1965].

[22] Intuitively, if an individual shareholder does not know the precise liquidity or capital gains situation of other shareholders, from her point of view their behavior is random. The logic described in the text causes shareholders to be near indifference, so that small uncertainties about payoffs lead to substantial uncertainty about behavior.

To develop this point, I follow the presentation of Holmstrom & Nalebuff [1992]. Consider a firm with N risk neutral shareholders each of whom owns a single share. Suppose that the bidder needs exactly K shares to obtain control. It is informative to focus on the symmetric equilibrium in which shareholders randomize with identical probabilities. Let the improved value of the target be $v = 1$. Shareholder i's tendering decision will be based on a comparison of the certainty of receiving the per-share offer price b/N versus a probability $P(b \mid i \text{ does not tender})$ of the per-share improved value of the firm $1/N$. She will be indifferent if

$$b = P(b \mid i \text{ does not tender}). \tag{10}$$

Let $p(b)$ be the probability that a single shareholder tenders, and let $P(b)$ be the probability that the offer succeeds given equilibrium behavior by all shareholders. Then the bidder's expected surplus is the difference between the total expected surplus, $P(b)$, and the expected surplus going to shareholders, b. Thus, the bidder's expected surplus is

$$P(b) - b = P(b) - P(b \mid i \text{ does not tender}). \tag{11}$$

On the RHS, $P(b)$ is the probability that at least K shareholders tender, and $P(b \mid i \text{ does not tender})$ is the probability that at least K shareholders other than i tender. The difference is therefore the probability that the other shareholders tender exactly $K-1$ shares, and shareholder i also tenders, i.e.,

$$_{N-1}C_{K-1}\; p(b)^K[1-p(b)]^{N-K}, \tag{12}$$

where $_{N-1}C_{K-1}$ is the number of combinations by which $K-1$ tendering shareholders other than shareholder i can be selected from the $N-1$ possible shareholders. Maximizing this quantity over p (which the bidder controls through b) gives the following proposition.

Proposition 9. *In the symmetric equilibrium of the any-or-all tender offer game of this section, the tendering probability is $p^* = K/N$, and the bidder's expected profit is positive. This profit approaches zero,* ceteris paribus, *as the number of shareholders N becomes large.*

By making the expected number of shares tendered equal to the number of shares needed for success, the bidder maximizes the probability that a given shareholder will be pivotal. The proposition's last statement is shown in Bagnoli & Lipman [1988].

Holmstrom and Nalebuff examine a more general setting in which shareholders hold any number of shares. They find an equilibrium in which all sufficiently large shareholders tender down to a common range of either m or $m+1$ shares. Large shareholders randomize between these two possibilities, the offer sometimes succeeds and sometimes fails, and the bidder makes a positive gross profit. Those with less than m shares do not tender. Since each large shareholder randomizes over just a single share, if the number of outstanding shares is large compared to the number of shareholders, the fraction of the firm tendered is always very close to the minimum needed to shift control.

If the number of shares is increased through stock splits, in the limit, even if the firm is widely held, the takeover almost surely succeeds, and the bidder's gross profit approaches fraction f of the takeover improvement, where f is the fraction of the shares needed to obtain control.[23] This equilibrium becomes very similar to the pure strategy equilibria of Section 3.2.2, in which just enough shares are tendered to ensure success and make shareholders pivotal. Here, the probability of failure must approach zero, because in equilibrium each shareholder can ensure success at low cost by tendering a vanishingly small additional fraction of her shares. Thus, they are always pivotal.

An implication of the Holmstrom–Nalebuff analysis is that if each shareholder holds a single share, then a supermajority antitakeover amendment, which increase the number of shares needed for control, increases the probability of offer success by increasing the probability that shareholders will be pivotal. The reason for this is that the probability that a shareholder is pivotal decreases with the variance in the total number of shares tendered. A supermajority rule corresponds to a higher probability of tendering in the mixed strategy equilibrium, which (with a tendering probability of greater than $1/2$) corresponds to a lower variance.[24]

3.2.4. The effects of offer revision with pivotal shareholders

The ability of a bidder to make repeated offers for a given target may be very important for the strategic structure of the takeover auction (see, e.g., the discussion at the end of Section 3.1.2.2). The option to bid a second time after failing to obtain control in an initial bid must benefit the bidder ex post, because he may obtain control on his second try. However, the possibility of a later offer reduces a shareholder's incentive to tender initially. The balance between these effects is not obvious. Harrington & Prokop [1993] find that with discounting, as the time between offers approaches zero, the expected gross profit to a tender offer bidder approaches zero. Their numerical simulations based on reasonable parameter values imply that bidders can obtain less than 1% of the takeover surplus.

3.2.5. Plausibility of equilibria with pivotal shareholders

The equilibria described in Sections 3.2.3 and 3.2.4, in which bidders profit on shares purchased because shareholders are often pivotal, are based on delicate coordination amongst shareholders. Realistically, in a firm with many small share-

[23] In a widely held firm, notwithstanding the fact that shareholders retain some of their shares, each internalizes only a small fraction of total value improvement arising from takeover. This is offset by the fact that there are many such shareholders, and each has a significant chance of being pivotal.

[24] Empiricists should note that this implication is the opposite of that of Hirshleifer & Titman [1990] discussed in Section 3.1.2, in which supermajority amendments reduce the probability of offer success by reducing the incentive to bid high (see footnote 15).

holders, it seems unlikely that shareholders perceive themselves to have a significant chance of being pivotal. Why don't the models match the *a priori* intuition?

In general, in games with many players, a plausible equilibrium (I contend) should be robust with respect to 'misbehavior' by a small (though not necessarily infinitesimal) fraction of individuals. Consider a widely held firm of N shareholders, and suppose that h of the shareholders will not tender their shares in the relevant range of offer prices, where h is a discrete random variable, $0 \leq h \leq H$, and H/N is 'small', but not infinitesimal (say $1/50$).[25]

I make the quantitative conjecture that under mild conditions on the distribution of h, there will be no equilibrium in which shareholders have a significant chance of being pivotal. The reason is that, not knowing h, strategic shareholders have no way of knowing how many shares they must jointly tender in order to make the offer succeed. Suppose shareholdings are identical, for example, with $H = 100$, and $N = 5,000$. Substantial exogenous uncertainty about the characteristics of even 100 shareholders would seem to make it exceedingly unlikely that the decision of a single shareholder will determine success or failure.

In experiments in which shareholders can tender all or none of their shares, Kale & Noe [1991] provide evidence that is only partly consistent with the argument provided here. They found that the probability of success in conditional tender offers to 41 shareholders was at some prices substantially below that predicted by a mixed strategy equilibrium with pivotal shareholders. However, the probability of success in any-or-all offers to 32 shareholders was greater than the equilibrium prediction.

4. Competitive bidding

Most models of the free-rider problem assume only one bidder for a given target. The models of competing bids discussed here generally makes the assumption that the target will always accept the highest offer made by any bidder, so long as it is above some minimum reservation price.

The analysis in this section should thus be viewed as referring to merger bids, or else to tender offers in which the threat of dilution limits free-riding. We focus on models of competitive bidding in which bidders have differing private valuations of a target, and examine the effects of investigation costs and bidding costs on auction outcomes.

Perhaps the simplest model of takeover bidding is the standard analysis of English auctions. In this model, bidders *costlessly* make offers and counteroffers, each bid incrementally higher than the previous one, until the bidder with highest valuation wins at a price equal to the valuation of the second highest bidder. I will call this outcome the *ratchet solution*.

[25] This 'misbehavior' could be rational, if their are costs of tendering such as locked in capital gains of size known only to the individual. The upper bound H could be quite low, e.g., $1/50$ of outstanding shares, but the argument may fail if probability bunches too close to zero. Thus, the plausibility concept suggested here differs in this respect from Selten's trembling hand equilibrium.

In the conventional English auction analysis, rather than paying a substantial initial premium, an initial bidder should bid the minimum reservation price, and increase the offer only if a competitor actually arrives. Suppose that the first bidder (*FB*) has a known valuation of $v_1 = \$80$, and a potential competing bidder (*SB*) has a valuation of $v_2 = \$0$, \$30 or \$100 with equal probability. Normalize the reservation price of the target to zero. Then *FB* will begin with a bid of zero. If $v_2 = 0$, *FB* buys the target at this price. If $v_2 = \$30$, *FB* still wins, but the price is driven up to \$30. If $v_2 = \$100$, then *SB* buys the target at a price of \$80. Competition in the bidding process not only helps target shareholders, it increases total surplus, because of the possible realization of a larger improvement (\$100).

The ratchet solution illustrates the potential gain to the target and society of competition. It is, however, not descriptive of actual takeover contests, in which initial bids are typically made at a substantial premium to the market price (see the empirical synopsis), and each successive bid typically involves a significant increase over the previous outstanding bid.

4.1. *Costly investigation and preemptive takeover bidding*

A possible explanation for a high initial bid in a takeover contest derives from the fact that takeover benefits are partly specific to the acquirer (e.g., complementarities), but partly common (e.g., gains derived from replacing inefficient target management). Owing to correlated valuations, an initial bid will alert potential competitors to the potential desirability of the target.[26] This suggests that in planning its initial offer, an initial bidder will consider the incentives created for potential competitors.

Specifically, such a bidder may wish to offer a substantial premium on his initial bid in order to deter potential competitors [Fishman, 1988; Png, 1985]. In Fishman's model, an initial bid alerts a second potential bidder to a state of the world in which the target is potentially profitable. However, the model assumes that conditional upon this state of the world, the valuations of the first and second bidder are independent. *FB* and *SB* can acquire information about the target at a cost of c^{I}. By investigating, a bidder learns his private valuation of the target.[27] If both bidders enter, it is assumed that a costless English auction ensues, so that the target is sold to the highest valuation bidder at a price equal to the valuation of the second highest bidder, $min(v_1, v_2)$ (i.e., the ratchet solution).

In the unique equilibrium in this game (applying the equilibrium concept of Grossman & Perry [1986]), the bidder offers the minimum reservation price for the target if his valuation is below a critical threshold level v^*. In this event *SB* investigates, and the target is sold in a costless English auction. If $v > v^*$, *FB* makes a high bid b^{D} that deters *SB* from investigating. The initial bid is therefore a coarse signal of the first bidder's valuation.

[26] See, e.g., Grossman & Hart [1981].

[27] Low valuations are assumed to be so likely that it does not pay to bid without investigating.

Suppose that the valuations of *FB* and *SB* are independent and uniform on the unit interval [0, 1]. I assume directly that *SB* only arrives if *FB* bids. *FB*'s payoff after a bid of b_1 is $v_1 - b_1$ if *SB* does not investigate. If *SB* does investigate, *FB* makes:

$$\begin{array}{ll} v_1 - b_1 & \text{if } v_2 \leq b_1, \\ v_1 - v_2 & \text{if } b_1 < v_2 \leq v_1, \\ 0 & \text{if } v_2 > v_1. \end{array} \tag{13}$$

SB's payoffs are zero unless he investigates. If he does, he makes:

$$\begin{array}{ll} -c_2^{\mathrm{I}} & \text{if } v_2 \leq v_1, \\ v_2 - v_1 - c_2^{\mathrm{I}} & \text{if } v_2 > v_1. \end{array} \tag{14}$$

SB as well as *FB* follows threshold behavior. If *FB* bids $b_1 < b_1^{\mathrm{D}}$, *SB* infers that $v_1 < v^*$, so *SB* investigates and a costless English auction ensues. If *FB* bids $b_1 \geq b_1^{\mathrm{D}}$, *SB* infers that $v_1 \geq v^*$, so *SB* quits.

To understand the equilibrium, first note that if *FB* offers less than b_1^{D}, he should bid zero, because *SB* will investigate and bid up to v_2 in any case. There is no gain to *FB* from bidding $b_1 > b_1^{\mathrm{D}}$, because he can already win with certainty at b_1^{D}. The gain to *FB* of bidding b_1^{D} instead of 0 is increasing in v_1, because his cost of bidding zero is greater when his valuation is higher. This is because *FB* with a larger v_1 values certainty of victory more highly, and because paying v_2 to beat the competitor whenever $v_2 < v_1$ has a greater expected cost when v_1 is higher.

The high deterring bid does *not* deter *SB* through the direct means of forcing him to pay at least b_1^{D}. Since $b_1^{\mathrm{D}} < v_1$, *SB* knows that if he investigates he must pay *more* than b_1^{D} to win. Rather, high b_1 *signals* to *SB* that $v_1 > v_1^*$, which makes *SB* pessimistic about his potential profit. Thus, it is reasonable for *SB* to follow a threshold rule in which he investigates if and only if the initial bid is below a critical value.

Specifically, *SB* is deterred if his expected profit from investigating is zero or negative, i.e.,

$$E\big[\Pi_2(v_1, v_2) \mid v_1 > v_1^*\big] \leq 0, \tag{15}$$

where Π_2 is *SB*'s profit as a function of the two valuations, and where *SB* believes that *FB* has valuation of at least v_1^*. *SB*'s profit does not depend directly on b^*, the level of the initial bid, only on the minimum valuation v_1^* communicated by the offer. Direct substitution from (14) and differentiation with respect to v_1^* shows that the LHS of this inequality is decreasing with v_1^*, because higher v_1^* makes *SB* more likely to lose and makes him on average pay more when he wins. This monotonicity leads to the threshold rule for *SB*.

To make expectations and actions consistent, the deterring bid b_1^D is set as a function of v_1^*, $b_1^D(v_1^*)$, defined as the maximum amount that *FB* with $v_1 = v_1^*$ would be willing to bid in order to preempt competition. This just prevents mimicry by any *FB* with $v_1 < v_1^*$.

There are multiple equilibria of this type, based on a value of v_1^* and the implied deterring bid value b_1^d. The lowest possible value of v_1^* consistent with this equilibrium sets (15) to zero so that *SB* is *just* deterred.[28]

To calculate v_1^*, set (15) to zero. Under the uniform assumption, this yields

$$c^{\mathrm{I}} = \int_{v_1^*}^{1} \int_{v_1}^{1} \left(\frac{v_2 - v_1}{1 - v_1^*} \right) \mathrm{d}v_2 \, \mathrm{d}v_1, \tag{16}$$

so

$$v_1^* = 1 - \sqrt{6c^{\mathrm{I}}}. \tag{17}$$

The deterring bid b_1^{D} makes *FB* with $v_1 = v_1^*$ indifferent between bidding to deter or to accommodate investigation. If he bids to deter, he gets

$$1 - \sqrt{6c^{\mathrm{I}}} - b_1^{\mathrm{D}}. \tag{18}$$

If he bids 0, he receives $v_1^* - v_2$ if $v_1^* > v_2$, and zero otherwise, for an expected gain of

$$\int_0^{v_1^*} (v_1^* - v_2) f(v_2) \, \mathrm{d}v_2 = \tfrac{1}{2}(v_1^*)^2. \tag{19}$$

Equating and solving for b_1^{D} gives

$$b_1^{\mathrm{D}} = \tfrac{1}{2} - 3c^{\mathrm{I}}. \tag{20}$$

The model has the following properties.

Proposition 10. *In the Fishman model, SB investigates only after a low-premium bid, not after a high bid. The level of the bid needed to deter competition is decreasing with the investigation cost c^{I}. The expected profit of FB is increasing and SB decreasing with c^{I}.*

The expected profit of *FB* is increasing and *SB* decreasing with c^{I}, because it is more expensive for *SB* to compete and thus cheaper for *FB* to preempt competition.

As discussed in Spatt [1989], the Fishman model has the excessively strong implication that an initial bid at a premium will always deter competition. Fishman suggests that if *SB* has private information about his investigation costs or valuation, then attempts to deter will sometimes fail (as analyzed by Bhattacharyya [1992]).

[28] Note that if *FB* is going to bid, he would prefer to pay the low $b_1^{\mathrm{D}}(v_1^*)$ rather than some higher amount. This equilibrium is the sole one consistent with the 'credibility' criterion of Grossman & Perry [1986].

Evidence consistent with the implication that a second bidder is less likely to compete after a high-premium bid than a low one has been provided by Jennings & Mazzeo [1993]. A further implication of the model is that a reduction in *SB*'s cost of investigation leads to a higher expected price of the target. This results from two reinforcing effects. First, if the investigation cost is low, then higher value must be signalled to deter competition, and hence a higher preemptive bid b^{D} is needed by (20). Thus the bid is higher in single-bidder contests. Furthermore, since deterring competition is more costly, *FB* makes the deterring bid over a smaller range of valuations, so that the higher expected price associated with competition is more often realized.

Lower investigation cost also increases efficiency. The social cost of competition comes from *SB*'s investigation cost c^{I}. The social benefit from competition is $max(0, v_2 - v_1)$, derived from the possible realization of a higher valuation than that of *FB*'s. Since in the ratchet solution a victorious *SB* profits by difference between his valuation and *FB*'s *SB*'s decision of whether to investigate is socially as well as privately optimal. Therefore, taking the occurrence of the initial bid as given, lower investigation cost improves efficiency by permitting realization of higher valuations. However, there is a crucial countervailing effect on the incentive of *FB* to investigate in the first place. A greater threat of competition can lead to too little initial investigation, and the loss of takeover gains.

Proposition 11. *Taking FB's investigation as given, a reduction in SB's cost of investigation c^{I} leads to a higher expected price of the target and greater social efficiency.*

4.2. Costly bidding

Fishman's and Bhattacharyya's models show that predictions that are more realistic than those derived from the costless English auction model can be derived when there are investigation costs associated with an initial offer. However, both authors assume that once both bidders have investigated, the game reverts to a costless English auction and the ratchet solution ensues. Several more recent papers extending the Fishman model for different purposes have made a similar assumption.

The ratchet solution may at first seem appealing in post-entry subgames, because of its tractability and because the costs of revising a bid upward are likely to be smaller than the setup and investigation costs needed for an initial offer. However, the conventional English auction analysis is extremely sensitive to small costs of bidding [Hirshleifer & Png, 1990]. To see this, suppose that *FB*'s valuation is known to be \$80, and *SB*'s is known to be \$30. In the ratchet solution, *SB* has nothing to lose by bidding up to \$30, which becomes the price paid by *FB*. Suppose now that there is a cost of bidding and of revising a bid of $c^{\mathrm{B}} = \$.01$. Then the target will be sold at a price of *zero*, because *SB* quits rather than wasting bid costs in a contest he must lose. Thus, even an extremely low bid cost drastically reduces the price paid for the target.

A possible justification for the ratchet solution is imperfect information. If *SB* does not know whether *FB*'s valuation is higher or lower, then he should be willing to incur some bid cost to preserve his chance of winning. There are two important limitations to this argument.

First, *FB*'s offer may signal his valuation. If so, a *SB* who knows his own valuation can make a well-informed decision as to whether to bid again or to quit immediately [see Daniel & Hirshleifer, 1993].[29]

Second, there are costs associated with revising an offer that may be far from trivial. First is the extension of the period during which managers must devote time to the takeover contest. Second are possible costs of obtaining further financing. Third, if takeovers will be associated with restructuring of the bidder and target, then real investment and operating decisions of the bidder may continue to be influenced by uncertainty over whether merger will occur. Fourth, some mandated filings may have to be repeated.[30]

By changing auction strategies, bidding costs can crucially affect the implications of takeovers models (see, e.g., the discussion of target defensive strategies in Section 4.3). When bid revision costs are added to Fishman's preemptive bidding model, it is still the case that *FB* can preempt competition through a high initial bid. However, Hirshleifer & Png [1990] show that a reduction in the cost of investigation c^{I} can *reduce* both the expected price paid for the target and efficiency. With regard to price, the difference arises from the much lower gains to the target when a second bidder investigates. Instead of a price of $\min(v_1, v_2)$, the premium may go up by little. Because of this, even though lower c^{I} raises the price that must be offered when *FB* deters investigation, the greater frequency of low offers that do not deter competition can lead to a lower target price on average. The welfare advantage of greater competition is also ambiguous since, with costly bidding, *SB* may sometimes succeed even if his valuation is below that of *FB*.

The Williams Act of 1968 and associated legislation discussed in the empirical synopsis has been widely viewed as reducing the cost to competitors of investigating after an initial bid [see, e.g., Jarrell & Bradley, 1980]. Evidence discussed earlier that average tender offer premia decreased after passage of the Williams Act is consistent with the costly-bidding analysis.[31]

An unrealistic implication of the assumption of costless bid revisions is that after a single initial jump, offers increase by infinitesimal increments. Daniel & Hirshleifer [1993] examine a model of costly sequential bidding in which the offered price jumps on each successive bid. In this model, since the initial bid signals *FB*'s valuation, *SB* either quits (if his valuation is below some critical value

[29] Note that even if the bid cost is small, more than a small amount of residual uncertainty about *FB*'s valuation may be required to induce *SB* to bid, because *FB*'s valuation must be sufficiently variable that it may be below *SB*'s valuation.

[30] Investigation as well as pure bid costs may be positive even after the initial bid, since more investigation may be required to justify the risk of a higher offer.

[31] Even in the costless bid revision model, a decrease in average premia could be predicted since initial bids will be observed from a lower valuation pool of bidders.

determined by *FB*'s signalled valuation), or else jumps to a bid high enough to induce *FB* to withdraw. Since *FB*'s offer reveals his valuation, any less conclusive response by *SB* would be wasteful of bidding costs without any corresponding gain. Daniel and Hirshleifer argue that the only plausible equilibrium in a sequential bidding model with bid costs has bids revealing valuation and substantial bid increments until the auction ends.

To understand why, consider the Fishman model with the investigation cost c^{I} replaced with a cost of bidding c^{B} that is incurred by a bidder *each time he bids*. This is a pure transaction cost (such as those described a few paragraphs earlier); paying c_B does not directly yield any information about valuations. It is simplest to analyze a limiting case of the Daniel–Hirshleifer model in which the bid cost is very close to zero. As the numerical example at the start of Section 4 suggests, the outcome will be very different from the conventional ratchet solution outcome with costless bidding.[32] Let $b_1(v_1)$ denote *FB*'s equilibrium bid as a function of his valuation. If this schedule is strictly monotonic, then the inverse function $\hat{v}_1 = \hat{v}(b_1) \equiv b_1^{-1}(v_1)$ is single-valued. This function is the inference schedule for *FB*, that is the valuation signalled by a bid of b_1.

Figure 2 illustrates the equilibrium geometrically when both bidders' valuations are drawn from a uniform distribution on $[0, 1]$. The horizontal axis represents *FB*'s valuation v_1 and his bid b_1. The vertical axis represents the inferred valuation of *FB*, $\hat{v}\,(b_1)$. In this example the inference schedule is a straight line. In equilibrium *SB* quits if $v_2 < \hat{v}_1$, so *FB*'s probability of winning with his first bid is $\Pr\,(v_2 < \hat{v}_1) = \hat{v}_1$. The bold line is the inference schedule. Inscribed in the large triangle is a rectangle with width $v_1 - b_1$, *FB*'s gain if he wins, and height $\hat{v}\,(b_1)$, *FB*'s probability of winning with his first bid. Suppose (as will be verified later) that in equilibrium *FB* will make only a single bid. Then the area of the inscribed rectangle is *FB*'s expected profit, and *FB*'s maximization problem is to set b_1 so as to maximize the area of this rectangle. Thus *FB* solves

$$\max_{b_1}\,(v_1 - b_1)\hat{v}(b_1) = \max_{\hat{v}_1}\,[v_1 - b_1(\hat{v}_1)]\hat{v}_1.$$

This problem is identical to that solved by a bidder in a first price symmetric sealed bid auction [see, e.g. Riley & Samuelson, 1981]. Differentiating with respect to $\hat{v}_1$ gives the first order condition of the latter problem. In equilibrium $\hat{v}_1 = v_1$, which gives the differential equation

$$v_1 b_1'(v_1) + b_1(v_1) - v_1 = 0, \tag{21}$$

with the initial condition that a low valuation leads to a low bid, i.e., $\lim_{v_1 \to 0} b_1\,(v_1) = 0$. The solution is $b_1(v_1) = v_1/2$, so the inference schedule is $\hat{v}(b_1) = 2b_1$, the straight line in Figure 2.

[32] Daniel & Hirshleifer describe a hitherto unrecognized weak signalling equilibrium of a costless English auction game ($c^{\mathrm{B}} = 0$). However, this is best viewed as a limit of strong equilibria as $c^{\mathrm{B}} \to 0$. Suppose (as will be shown) that the initial bid signals the true valuation v_1. If there is a positive bidding cost, however small, then after v_1 is revealed, *SB* with $v_2 < v_1$ strongly prefers to quit. Hence, bidding ends at a price below $\min(v_1, v_2)$, the price under the ratchet solution.

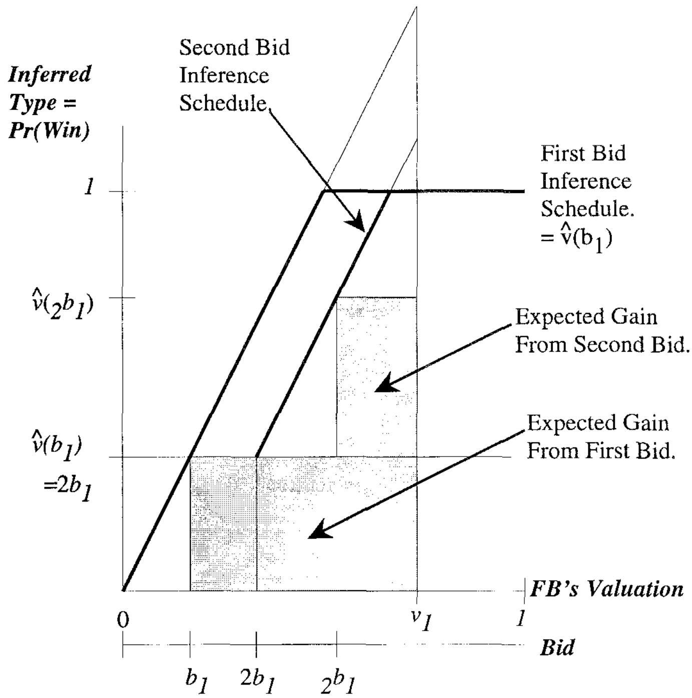

Fig. 2. Geometric interpretation of the signalling equilibrium.

Interestingly, the bid is equal to the expected price paid by *FB* conditional on his winning in the ratchet solution,

$$E\left[\tilde{v}_2 \mid \tilde{v}_2 < v_1\right] = \frac{v_1}{2}. \tag{22}$$

Thus, *FB*'s expected profit as a function of his valuation,

$$\left(v_1 - \frac{v_1}{2}\right) \Pr\left(\tilde{v}_2 < v_1\right) = \frac{(v_1)^2}{2}, \tag{23}$$

is the same as in the ratchet solution.[33]

In response to the initial bid, *SB* withdraws if $v_2 \leq \hat{v}_1$, and wins with a bid of $b_2 = \hat{v}_1$ if $v_2 > \hat{v}_1$. *SB* does not bid less than $\hat{v}_1$ because in this equilibrium *FB* always infers skeptically that *SB*'s bid is virtually as high as *SB*'s valuation.[34] Thus

[33] *FB*'s bidding schedule in (22) depends not on the distribution of his own valuation, but on the distribution of his *opponent's* valuation. This is because the differential equation (21) derives from *FB*'s choice problem, which weighs the extent to which raising his bid will reduce the probability that his opponent's valuation will lead to a competing bid.

[34] *FB* would top any bid below $\hat{v}_1$ in order to force out *SB*. Thus, *SB* will never bid below $\hat{v}(b_1)$. There are other equilibria in which *FB* is less skeptical about *SB*'s valuation; these are broadly similar to the equilibrium discussed here.

SB's expected price paid and expected profit as a function of this valuation are respectively as given in (22) and (23) with subscripts 1 and 2 reversed.

Before analyzing *FB*'s possible defections in more detail, it is useful to summarize some implications.

Proposition 12. *If two risk neutral bidders have valuations that are uniformly distributed on the interval* $[0, 1]$ *and the bid cost* $c^B = 0$*, then there exists a weak equilibrium in which the FB offers half his valuation as his initial offer. This offer is the same as FB's expected payment, given that he wins, in the ratchet solution. SB, if he wins, pays FB's valuation, the same amount as in a ratchet solution.*

In this special case of zero bid costs, the first bidder's bid schedule is the same as that in a conventional first price sealed bid auction, and the bid schedule in Bhattacharyya [1992] (as the one-shot entry fee approaches zero). The *realized* price in the sealed first price auction differs, since the winning bid in this auction essentially never matches the ratchet solution outcome.

To see that this is an equilibrium when *FB* can bid repeatedly, note first that *FB* would never bid higher than the proposed bidding schedule because, if he did, and *SB* followed with his equilibrium response $b_2 = \hat{v}_1 > v_1$, *FB* would quit. As was already shown, if *FB* plans to bid at most once, he will bid on the proposed schedule.

So consider instead a defection by *FB* of initially bidding low ($b_1 < v_1/2$), and if *SB* responds with a higher bid, bidding a second time to signal his true valuation v_1. The initial offer signals his type to be $v(b_1) < v_1$. SB's equilibrium response to the initial offer is either to withdraw or else to win with a bid of $v(b_1)$. If *SB* bids, and *FB* responds, then SB's bidding decision will depend on his inference after observing this off-equilibrium occurrence. Let us assume that *SB* interprets *FB*'s second bid as a new and (this time) truthful separating bid.[35] *FB*'s two-bid maximization problem is illustrated in Figure 2. *FB* expected profit derived from states of the world in which *SB* quits immediately after the initial bid is $2b_1 (v_1 - b_1)$, the large lower rectangle. *SB*'s equilibrium responses are either to quit or to bid *FB*'s signalled valuation of $v(b_1) = 2b_1$. If *SB* bids, *FB* infers that *SB*'s type is distributed uniformly on $[2b_1, 1]$. Analogous to the equilibrium schedule on the first bid, to signal his type as v_1, *FB* must bid $b_1' = (v_1 + 2b_1)/2$. *FB*'s expected profit derived from states of the world in which he makes a second bid is therefore $(v_1 - 2b_1)^2/2$, the smaller upper rectangle. Thus the *total* expected profit from both bids, the sum of the rectangular areas, is $v_1^2/2$, which is *independent of the amount bid*, and the same as if *FB* did not defect. This confirms the proposed (weak) equilibrium.

By defecting to a low-bid strategy, *FB* pays less than with the truth-revealing strategy if *SB* quits. However, he pays considerably more if he wins on a second

[35] This is a conservative assumption. If, once convinced by the first signal that $v_1 = \hat{v}_1$, *SB* would never change his mind, he would be less willing to withdraw, making *FB*'s defection even less profitable.

bid, so his expected profit is no higher with the low-bid strategy than with the truth-revealing strategy. As Daniel & Hirshleifer show, with a strictly positive bidding cost, his profit from the low-bid defection is *strictly* lower.[36]

Proposition 12 implies that the signalling equilibrium leads to a surprising identity of expected payoffs between the bidders, and with other auction mechanisms.

Proposition 13. *Both unconditionally and conditional on his own valuation, each bidder is indifferent between the signalling equilibrium and the ratchet solution. If target shareholders are risk neutral, then they are also indifferent. The two bidders earn the same expected profits, so who moves first is a matter of indifference.*

Thus, the revenue equivalence of optimal auctions [see Myerson, 1981; Riley & Samuelson, 1981] extends to the sequential bidding game (when bid costs approach zero). Since the ratchet solution provides the bidders and stockholders with the same expected revenue as a sealed bid first or second price auction, the signalling equilibrium described here provides the same expected revenues as well.[37]

When a specific level of the bid cost is considered (instead of the limit approaching zero), the Daniel–Hirshleifer model implies that a bidder with low valuation may wait one or several rounds before bidding. Suppose the game continues until one player makes a positive offer and the other player quits. If neither bidder makes an offer in the first round, *FB* gets another chance to bid in the second round. In this setting, a low valuation bidder will wait rather than bid. To illustrate, consider the uniform example with a bid cost of 0.01. A bidder with valuation of 0.1 has a 0.1 probability of winning. If he bids zero and wins, his gross profit is 0.1, so his expected gross profit is $0.1 \cdot 0.1 = 0.01$, leaving him zero net profits. By waiting, he can obtain positive expected profits, so no type with $v_1 \leq 0.1$ will bid in the first round. If *SB* similarly passes, *FB* learns that *SB* valuation is low, which raises *FB*'s chance of winning. At this point *FB* may submit a bid. Each further round of waiting reveals lower valuations, increasing the incentive to bid. Eventually any bidder whose valuation exceeds the bid cost c^{B} will submit a bid, but he may need to wait many rounds before doing so.

Prices jump either once or twice in the version of the Daniel–Hirshleifer model discussed here. They also suggest when there will be a greater number of bids. First, further information disclosed during the contest can alter bidder valuations. Second, the target may undertake defensive measures that shift bidders' valuations (see Sections 3.1.3.2 and 4.3). Third, when there are n bidders, the price jumps up to n times, as each of the first $n-1$ bidders either signals his type or quits.

[36] *FB* could also contemplate a low bid followed by a contingency plan involving several possible further bids. It can be shown by similar reasoning that such defections are not profitable.

[37] Although the bidding process and strategic reasoning is different, the final outcome with arbitrarily small bid costs in every round is identical to a game with only a small entry fee (followed by the ratchet solution if *SB* enters). However, if there is a significant investigation cost or entry fee, the first bid will not fully reveal the bidder's valuation [Fishman, 1988; Bhattacharyya, 1992]. In such settings, the introduction of small bid costs in later rounds drastically affects final outcomes as well as the bid process.

Their signalling equilibrium suggests that bidders will make substantial bid jumps in order to drive out unmotivated competitors not just initially (as in Fishman & Bhattacharyya), but at every stage of a sequential auction. However, the existence of a signalling equilibrium does not rule out alternative equilibria in which pools of bidder types are gradually revealed through small bid increments. Daniel & Hirshleifer argue that reasonable equilibria in costly sequential bidding games have the property that bidders bid in substantial increments in order to signal in the minimum number of moves enough information to determine the contest winner. In this view, the outcomes of sequential bidding games with even modest bid costs will not resemble the conventional ratchet solution to the English auction.

The intuition is roughly as follows. If in equilibrium pooling disappears with certainty within a given number of rounds of bidding, then a backwards recursion argument indicates that it pays to bid to win earlier rather than risk incurring extra bid costs. Suppose instead the equilibrium calls for 'dueling pools' that potentially last any number of rounds, gradually shrinking as offers grow. Then a bidder whose valuation is near the top of a pooling interval foresees a chance that, after his current bid, he will need to bid again. To avoid the extra bid cost, he will defect to a higher bid in the current round. If a high valuation bidder has a stronger incentive to signal in this fashion than a low valuation bidder, this defection can credibly deter the competitor. Profitable defection unravels the dueling pools from the top.

4.3. Managerial defensive measures and bidder elimination

In Subsection 3.1.3, management defensive measures were analyzed in single-bidder contests. In multiple-bidder contests, the possibility exists of using defensive measures as means of discriminating among bidders. The extreme case of discrimination between bidders is to take an action that eliminates one bidder but not others. Shleifer & Vishny [1986b] show that it is possible for a target firm to profit from payment of greenmail to a bidder, in order to signal to other potential bidders that the target does not have a hidden 'white knight' bidder ready to top all offers.[38] This encourages investigation by other bidders. Since the fact that the target does not have a hidden white knight can be bad news for shareholders, the stock price reaction to greenmail can be negative (consistent with evidence cited earlier) even if it benefits target shareholders.[39]

Spatt [1989] describes and generalizes an example due to Sudipto Bhattacharya in which several potential bidders decide simultaneously whether to pay an entry fee in order to participate in bidding. Spatt concludes that even under full

[38] Greenmail is the repurchase at a premium of the shareholdings of a potential takeover bidder, often combined with a standstill agreement that prevents the bidder from further purchases of target shares.

[39] This last implication is shared by the model of Giammarino & Heinkel [1990], which is based on greenmail signalling that the target has greater value under current management than if investment levels are cut by an acquirer.

information the elimination of some members of a group of potential bidders can increase the expected profit of the target when an increase in the entry fee does not. The example assumes the conventional ratchet solution among those bidders that enter.

In summary, several models have demonstrated the theoretical possibility that the elimination of potential bidders can sometimes improve efficiency and help target shareholders. But since the conditions needed for elimination to be in shareholders' interests seem to be restrictive, it would be desirable to develop empirical tests to distinguish these models from the common view that greenmail promotes undesirable entrenchment of target management.

As these models show, even a defensive strategy that is good for target shareholders can reveal bad news. However, there are perhaps stronger reasons to expect defensive measures to convey favorable information (even if they are undesirable). One expects management to be more likely to oppose a takeover at a given price if it has favorable information about firm value, or about the likelihood of other bidders arriving. Furthermore, a defensive strategy can be good for shareholders given the arrival of a bid, and yet undesirable ex ante because it deters investigation. The negative average stock price reactions associated with various kinds of defensive measures cited earlier suggests that these actions are often undesirable for target shareholders.

Instead of buying off the bidder, the target can raise the cost to a bidder by repurchasing shares from other investors. Aside from signalling effects (see Section 3.1.4), a repurchase can forces the bidder to offer more if the supply curve of shares slopes upward [Bagwell, 1991]. For example, if different investors have different capital gains bases, repurchase takes out the shareholders with lowest reservation prices. Thus, the greater is shareholder heterogeneity, the more effective is repurchase in blocking takeover.

As emphasized by Jensen [1986], the distribution of cash through repurchase can be a good thing if management would otherwise be inclined to overinvest, and can reduce the gain from takeover. More generally, a management can help preserve its control by preempting the improvements that might otherwise be effected through a hostile takeover. The issue of whether the threat of takeover on the whole improves efficiency (by giving managers a 'kick-in-the-pants') or harm it (by inducing risk avoidance and 'short-termism') is a topic of current debate.[40]

Uncertainty about how much a firm's management values control affects the information conveyed by target resistance activity [Baron, 1982]. If the manager is a shareholder, then he may reject an offer if he has private information indicating that the target is worth more than the price offered, or because he places high value on retaining control. In Baron's model, the expected value of making an offer to a manager who values control is negative because of an associated adverse selection problem, that the offer will only be accepted if it is too high. The rejection of an offer leads outsiders to revise upward their beliefs about the

[40] See, e.g., Stein [1988] and other models reviewed in Hirshleifer [1993a]

manager's value of control, discouraging further offers and causing bidders to shade their offers downward.

As with the analysis of takeover auctions in general, it is important to take into account bidding costs to arrive at robust conclusions about the effects of defensive strategies (see Section 4.2). Berkovitch & Khanna [1990] examine a model in which a target takes an action that reduces its value more to an initial bidder than to a potential second bidder. An example would be selling an asset that can be improved more by *FB* than *SB*. The advantage of this is that it encourages *SB* to compete, despite an entry cost, and forces the first bidder to make a higher offer to deter value reduction and competition.[41]

The following numerical example illustrates their model under full information. Suppose that *FB*'s valuation is \$80, and *SB*'s valuation is \$30. Suppose that *SB* has a cost of \$5 for its *initial* bid only, and that if *SB* enters, the ratchet solution of a costless English auction ensues thereafter. Assume no defensive measures. Then *FB* will succeed with an offer just above zero. Now allow the target, after the first bid, to reduce *FB*'s valuation by an arbitrary amount without changing *SB*'s valuation. *FB* will now win at a price of \$25.[42]

The outcome is very different when bid revision is slightly costly. Suppose that after *SB* enters, there is a further cost of bidding of \$0.01 for either bidder. Suppose in addition there is a cost of \$0.01 to the target of value reduction. (For example, value reduction is likely to be costly if there is a slight chance that no acquisition will take place.) Now, even with value-reduction strategies, *FB* will win at a price of \$0.[43] More generally, the gains from stimulating a competing bid are greatly reduced by even small bid costs in later rounds of bidding.

4.4. *Bidder debt as a strategic positioning device*

Debt can play an important strategic role in takeover contests. The role of target debt is discussed in Section 6; here I discuss the bidding side. Merging has a risk-combination effect that can benefit either bidder debt- or equity-holders, depending on capital structures, the probability distributions for separate and combined firm cash flows, and the means of payment. To disentangle other effects, consider acquisitions without merger.

High leverage increases the bidder's incentive to prefer risky investments (especially if financed by further debt). This increases the incentive to bid high. Thus, an initial bidder may obtain a strategic advantage by leveraging his firm, thereby

[41] Giammarino & Heinkel [1986] provide a related model in which an uninformed bidder is reluctant to compete against an informed bidder when valuations are common. This leads to a gain to the target of committing to resist counteroffers by the informed bidder.

[42] If *FB* offered any less, \$20 say, then the target would reduce *FB*'s valuation of the target to just below \$25. *SB* would win the English auction at a price of just under \$25, to make a small profit.

[43] If the target responds to a first bid of \$0 by reducing *FB*'s valuation to below \$25, then *SB* will enter, *FB* will quit, and *SB* will win at a price just above \$0. But this means that the target has lost \$.01 from its value reduction strategy. Hence, the threat to reduce value is not credible.

committing to bidding aggressively. While this reduces the cost of deterring competition, if the first bidder is imperfectly informed about potential competition, in equilibrium a competitor will still sometimes investigate and bid. In such cases, an equity-value-maximizing bidder may buy the target above its value to the bidding firm as a whole [Chowdhry & Nanda, 1993].

Chowdhry and Nanda's conclusion that debt helps a bidder commit to aggressive bidding conflicts with the popular view that a bidder with high debt is 'strapped for cash', hence unable to afford a high offer. The popular view is consistent with the underinvestment problem with debt [Myers, 1977]; if debtholders absorb part of the value-improvement from takeover, shareholders may have insufficient incentive to undertake it.

Which view is correct? The advantage of issuing new debt to expropriate old debtholders (which does not occur in the Chowdhry/Nanda model) can be achieved without an acquisition, and so is not a benefit to bidding high. If the bid is financed internally, shareholders are sacrificing dividends to make the purchase, so the underinvestment problem will normally apply. However, some acquisitions probably create substantial risk of generating losses greater than the purchase price (reducing the value of the bidder's assets-in-place). In this case part of the potential loss from the investment is borne by debtholders, so overbidding may be profitable for equityholders. Finally, the risk-combination effects of merger in redistributing wealth between debt and equity can operate in either direction.

4.5. *Initial shareholdings as a strategic positioning device*

Another way to commit to aggressive bidding in takeover contests is to accumulate an initial shareholding in the target [Burkart, 1994]. A simple numerical example (developed independently of Burkart's paper) illustrates these incentives. Suppose there are two bidders with valuations known to be \$100 and \$200. If there are no initial shareholdings, the high-valuation bidder will win at a low price: \$0 if there is even a small transaction cost of bidding (or \$100 in the costless English auction solution). Suppose now that the low-valuation bidder owns an initial fraction $\alpha > 0$ of the target firm. He will now bid up to \$200 $- \epsilon$, ($\epsilon > 0$ small), in order to sell his stake to the winning bidder at the highest possible price. Thus, initial shareholdings can lead to drastic overbidding.

This threat of overbidding can deter potential new bidders from investigating. If the initial bidder has a low valuation, he may prefer not to deter competitors, since he would rather sell out at a higher profit. His initial offer may attract competition by conveying information about possible value improvements. Some corporate 'raiders' have in fact been accused of making bids to put companies 'in play', with the intention of selling out.

An initial bidder with a high valuation would like to deter low-valuation competitors. But deterrence may be incomplete, because it may be profitable for another bidder to accumulate a stake (even at prices elevated by takeover speculation), drive up the price further, and sell out to the first bidder. This possibility reduces the expected value to investigating and becoming an initial bidder. Thus, ironically, it seems that the potential to accumulate initial shareholdings may *reduce* takeover activity.

If the bidder does not know the valuation of his competitor, his incentive to overbid is weakened, because he runs the risk of driving out the competitor. A critical strategic factor then is whether the bidder is contractually committed to following through with an acquisition offer. Another limit to overbidding is the difficulty of obtaining financing for an offer that is likely to either lose money or just lose.

4.6. Bidding for multiple targets

Some bidders, such as corporate 'raiders' or firms building conglomerates, have engaged in programs of repeated acquisition. In general, when a repeating player has private information about some strategically relevant characteristic, there can be an incentive to select actions in early rounds that help to build reputation [see, e.g., Kreps, Milgrom, Roberts & Wilson, 1982; Fudenberg & Levine, 1989]. A repeated takeover bidder may want to bid relatively low in early contests, because if later targets believe he can bring about large improvements, they may insist on higher prices [Leach, 1992]. Leach provides evidence which suggests that repeat bidders bid lower than nonrepeaters.

5. Means of payment

The means of payment (cash versus debt or equity securities) in takeover contests has important consequences for the information revealed by the bidder and the target and the efficiency of the transaction outcome. Four key factors have been emphasized by recent theoretical research:

(i) *Value of equity in limiting overpayment* [Hansen, 1987; Eckbo, Giammarino & Heinkel, 1990]. If the target has some private information about its value or the value of the takeover, then the bidder faces a tradeoff between the likelihood of paying too much, or of offering too little and being rejected. The latter case is inefficient. Equity makes the terms contingent on the target's value, mitigating adverse selection.

(ii) *Cash as an indicator of high value or valuation, and equity as an indicator of low value or valuation* [Myers & Majluf, 1984; Hansen, 1987; Fishman, 1989; Eckbo, Giammarino & Heinkel, 1990; Berkovitch & Narayanan, 1990]. Equity (or risky debt) is cheaper for a bidder that is overvalued, or whose valuation of the target is low, so the offer of cash instead signals high value or valuation. For example, a bidder can preempt competitors by offering cash. However, empirically cash does not seem to be associated with less competition [Jennings & Mazzeo, 1993]. With mixed offers value can be revealed fully. If the target has bargaining power, a bidder may offer equity to signal low valuation and induce the target to accept less.

(iii) *The use of equity to exploit the target's information* [Fishman, 1989]. If the bidder is not sure whether a merger will create or destroy value, it is valuable to exploit the target's information. An equity offer gives the target a share of takeover gains or losses, so it will tend to reject undesirable transactions.

(iv) *Tax advantages of equity* [Brown & Ryngaert, 1991]. In the U.S., tax-free status depends on at least 50% of consideration being in the form of equity; many offers occur at or near 50%.

A stimulus to this theoretical research has been evidence (discussed in the empirical synopsis) of lower bidder and target returns for stock offers than for cash offers (see point (ii) above). The failure of the U.S. result of negative average abnormal bidder returns to carry over to other countries is puzzling.[44] Further research will help clarify the source of the inconsistency between theory and evidence.

The use of securities as a means of payment is a case of what Riley [1988] refers to as use of ex-post information to set auction payoffs. Riley shows that a *seller* who can set the payoff function, will want to use ex-post information. This suggests that sellers may insist upon an appropriate debt–equity bundle in order to reduce the problems of asymmetric information about buyers' valuations. Applications of these ideas to takeovers may be of interest for further research.

6. Target financing, managerial voting power and private benefits of control

6.1. *Debt as a means of preempting takeover benefits*

Debt is frequently increased by potential takeover targets either before or after the arrival of a bidder. A possible explanation is that the purpose of hostile takeovers is to cut expenses and investment. If there are agency problems associated with free cash flow that are reduced by debt [see Jensen, 1986], then the target can commit to preempting the bidder's planned cutbacks by increasing debt.[45] Alternatively, if managers who value control are reluctant to risk financial distress to exploit heavily the tax advantage of debt, they may shift to higher debt when a takeover threat appears.

6.2. *Debt as a means of capturing takeover benefits*

An alternative theory is that high leverage allow the target to capture a greater fraction of a bidder's improvement through increases in the value of debt [Israel, 1992]. The greater the improvement in firm value associated with a takeover,

[44] Since stock is associated with mergers, and cash with tender offers, it is hard to distinguish acquisition form from means of payment. Since cash tender offers can be consummated more rapidly than stock offers, returns may also be related to the mood of the takeover and prospects for competition.

[45] However, on average investment was not reduced following successful hostile takeovers in the mid-1980s [see Bhide, 1989; Bhagat, Shleifer & Vishny, 1990].

ceteris paribus the lower the probability of default on target debt. If the possibility of takeover-related improvement in debt value can be foreseen by purchasers of debt in advance, target shareholders can absorb this gain at the time of debt issuance. A limit to debt issuance is that this reduces the incentive of potential bidders to investigate the target [Israel, 1991],[46] consistent with evidence cited earlier that high debt targets are less likely to receive hostile tender offers. Similarly, going public can have the advantage of introducing a free-rider problem in tendering [Zingales, 1991]. If dilution opportunities are limited, then public shareholders, by virtue of the free-rider problem, are effectively committed to bargaining tough with the bidder, allowing them to absorb more of the takeover gain than would a single firm owner. The owner can absorb these potential profits at the time of equity issuance.

6.3. *Use of resistance strategies to influence contest form*

Harris & Raviv [1988] describe how target management, through its resistance strategy, can influence the form of the takeover contest and the likelihood that control changes. They focus on the relationship between target debt levels and two alternative corporate control mechanisms: proxy fights and tender offers.[47] In their model, shifts in capital structure at the time of a control contest affect management's voting power and gains from a control change. Management's resistance strategy is based on a trade-off between value improvements brought about by control changes, and management's private interest in retaining control benefits.

Their model focuses on the behavior of incumbent management (I), a rival management team (R), and passive investors (P). Passive investors may vote in a proxy fight for I or R, but do not seek control for themselves. Both I and R may have either high or low ability. If ability is high, the NPV of the firm (Y_H) is greater than if ability is low (NPV= Y_L). Managers do not have any superior information about their ability. When R arrives, all agents assess a probability p that I is better than R, $1 - p$ that R is better than I, and 0 that they are equally able. Prior to R's arrival, p is distributed uniformly on $[0, 1]$. Each passive investor receives an i.i.d signal about the relative abilities of I and R. If a proxy fight occurs, each passive investor votes for the control candidate he believes is better based on p and her signal. If I is actually of ability $i = H, L$, then $\pi_i(p)$ is the probability that a passive investor will vote for I, with $\pi_H(p) > \pi_L(p)$. With many small passive investors, $\pi_i(p)$ is also the fraction of small investors voting for I.

I and R have limited amounts of wealth available to invest in the firm's equity, W_I and W_R. When a potential rival for control of a firm appears, target management may initiate a debt-for-equity exchange to increase its voting power.

[46] It is also possible that an acquirer can expropriate target debt by shifting dividend or investment policy.

[47] A third mechanism of corporate control is dismissal of top executives by the board of directors.

Let D be the face value of debt issued when a takeover threat begins. Debt affects firm value only through its effect on who ends up managing the firm. Higher D reduces I's benefit from control, $K_i(D)$, as it increases the probability of bankruptcy. For any level of debt D, control benefits are greater for a high than for a low ability manager, $K_1(D) > K_2(D)$.

The sequence of events is as follows. Before R appears, the firm makes an initial investment of \$1, financed by \$ W_I from I and \$ $1 - W_I$ from passive investors. I initially selects zero debt. When R appears, I decides on the size of a debt-for-equity exchange in order to maximize the sum of the value of his shares and his expected benefit from control. After any such exchange, R decides whether to purchase equity. Passive investors then observe their signals about managerial ability. A shareholder vote then determines control of the firm.

The value of the firm if no control change is possible is

$$Y_I \equiv pY_1 + (1-p)Y_2. \tag{24}$$

Let α_I be the initial fraction of the firm owned by the incumbent. After issuing debt in exchange for nonmanagement equity, I's equity share becomes

$$\alpha_I(D) = \frac{\alpha_I Y(D)}{E(D)}, \tag{25}$$

where $Y(D)$ and $E(D)$ are the market values of the firm and of the firm's equity when the face value of the debt is D. The numerator is the value of the manager's old shares when it becomes known that debt will be increased, and the denominator is the total value of the firm's equity after recapitalization. Y and E depend on D because D, by affecting ownership fractions, affects the outcome of the control contest.

If the rival appears, he invests his wealth W_R in equity. An upper bound on his purchases is that he can buy no more than $1 - \alpha_I$, the holdings of passive shareholders. Thus, his purchase is

$$\alpha_R(D) = \min\left[\frac{W_R}{E(D)}, 1 - \alpha_I(D)\right]. \tag{26}$$

The remaining fraction of the firm's equity is held by P.

The incumbent's problem is then to set debt to solve

$$\max_{D \geq 0} \alpha_I Y(D) + K(D), \tag{27}$$

where $K(D)$ denotes the expected control benefit to the incumbent given debt level D. There are three possible cases:

1. R acquires enough shares to guarantee he obtains control.
2. Neither R nor I is certain of control.
3. I increases his fractional ownership so much that he is certain to retain control.

These three cases are suggestively termed *successful tender offer*, *proxy fight*, and *unsuccessful tender offer*, respectively. In a successful tender offer, R obtains control even if he is inferior to I. In an unsuccessful tender offer, I retains control even if he is inferior to R. In a proxy fight the superior candidate always wins, because passive investors in the aggregate always cast more votes in favor of the superior candidate.

I's total vote in a control contest is

$$\alpha_I(D) + \pi_i \alpha_P(D), \tag{28}$$

where $i = 1$ if I is better and $i = 2$ if R is better. Thus, an unsuccessful tender offer corresponds to a level of debt such that (28) is at least $1/2$ even when $i = 2$. A successful tender offer corresponds to a level of debt such that (28) is less than $1/2$ even when $i = 1$. A proxy fight corresponds to debt levels such that (28) is less than $1/2$ if $i = 2$, but at least $1/2$ when $i = 1$.

If I selects a given case, he will optimally select the lowest debt level consistent with that case. This is because debt affects the control outcome only when it changes the case, while higher debt always reduces I's expected benefit of control. Thus, if I chooses to permit a successful tender offer, he will choose a debt level $D = 0$. It is assumed that a positive level of debt is needed to bring about an unsuccessful tender offer. A positive level of debt may be needed to force a proxy fight.

Because of the role of leverage in blocking control change, greater debt issuance is associated with those types of transactions that maintain incumbent control. Some implications of the model for leverage are now summarized.

Proposition 14. *In the Harris–Raviv model, leverage-increasing shifts in financial structure occur during control contests. Since greater incumbent shareholdings are required to prevent a control shift than to allow one, leverage increases are predicted to be on average smaller for targets of successful tender offers than for firms involved in proxy contests (in which control may not shift) or unsuccessful tender offers. So long as passive shareholders are sufficiently well-informed, the average increase in debt is lower among firms involved in proxy contests than in the unsuccessful tender offer case.*

The analysis also has implications for stock price reactions to control contests, summarized as follows.

Proposition 15.

(1) The average target abnormal stock return associated with successful tender offers (in which control change is certain) is larger than the abnormal returns associated with a proxy fight (in which a change in control is uncertain).

(2) The target stock price does not increase on average, in an unsuccessful tender offer.

(3) Thus, even an unsuccessful proxy fight is associated with positive abnormal stock return.

(4) The abnormal return associated with a successful proxy fight is higher than for an unsuccessful one

(1) holds because incumbent management will risk relinquishing control if the likelihood that the rival is more efficient is sufficiently large, since this increases the potential capital gain on management-owned shares. (2) holds because no value improvement is effected; it is consistent with the evidence of Bradley, Desai & Kim [1983] discussed earlier. (3) holds because the winner of a proxy fight is the more efficient management team. (4) holds because success is associated with a lower ex-ante probability that incumbent management is efficient, and thus a lower prior stock price.

6.4. *Target management ownership and resistance when the supply of shares is upward sloping*

Stulz [1988] offers related arguments concerning the defensive role of target management share ownership and capital structure in a model that focuses on tender offers. He considers an incumbent manager who wishes to retain control and owns shares of the firm. The greater his holdings, the smaller the remaining share fraction available for purchase by a potential bidder. (The incumbent's shareholding can be adjusted through changes in leverage and other means.) Under the assumptions of an upward sloping supply curve for shares, and that the target manager values control so much that he never tenders, it follow that the bidder must pay a larger premium for a given probability of success. (For a related argument, see Bagwell [1991].)

Under these more adverse circumstances, the bidder will in fact offer more. To see this, consider a slightly modified equation (5), so that the bidder's expected profit is

$$E[\Pi] = P(b; m)(v - b), \tag{29}$$

where $P(b; m)$ is the bidder's probability of success as a function of the amount offered b and target management share ownership m, and where v is the bidder's valuation of the target. The first order condition is

$$P'(b; m)(v - b) = P(b; m). \tag{30}$$

Suppose that the probability of offer success is linearly increasing in the bid and is linearly decreasing in the level of target management share ownership,

$$P(b; m) = a_0 + a_1 b - a_2 m. \tag{31}$$

This simplified equation reflects two considerations in Stulz's analysis. First, a higher offer increases the probability that the bid will exceed the unknown reservation prices of a large enough fraction of shareholders that the offer will succeed. Second, an increase in the fraction of shares not available for tendering m decreases the probability of success. Then substituting (31) into (30) and solving for b gives

$$b(v; m) = \frac{v}{2} - \frac{a_0}{2a_1} + \frac{a_2 m}{2a_1}. \tag{32}$$

By (32), this argument implies the following proposition.

Proposition 16. *The level of the bid is increasing with target management share ownership, m.*

This result may seem surprising, because with an upward sloping supply curve for shares, a higher target management ownership raises the cost of purchasing shares. One might suppose that this higher cost could induce the bidder to reduce his offer and accept a lower expected number of tendered shares. The reason this does not occur is that, for any given offered price, the lower probability of success reduces the expected marginal cost of increasing the level of the bid (the price increment multiplied by the probability of success). Thus, the bid increases. The evidence of Stulz, Walkling & Song [1990] discussed earlier that supports the prediction of Proposition 16, particularly for multiple bidder contests.

The paper goes on to examine the consequences of target management shareholding for firm value. Stulz finds that increased managerial ownership does not necessarily improve shareholder welfare because it facilitates the entrenchment of the incumbent manager in control contests. As the incumbent management's shareholding increases, the target loses from a reduction in the probability of a successful takeover, but benefits from a higher premium in the event of success. Private benefits of control in effect serve as a commitment not to tender. In general, such commitment can have strategic value [Schelling, 1960]. Here, the manager is strategically positioned to force the bidder to raise the premium. This leads to an interior optimum from shareholders' point of view.

A number of different kinds of corporate actions can lead to effective increases in management control of voting rights. First, as in Harris and Raviv, shifts in capital structure can effect this end. Thus, the model predicts that the probability of a hostile takeover attempt is decreasing with the target's debt–equity ratio (consistent with evidence cited earlier). Another way of maintaining high management control of voting rights may be to delay the call of a convertible debt. The negative common stock price reaction to the announcement of forced conversion of debt into common stock could then be due to the fact that this reveals to the market that the firm is unlikely to be a takeover target. Since a supermajority rule make takeover more costly for the bidder, Stulz predicts that these can either increase or decrease firm value, but that a decrease is more likely when managerial shareholdings are high (consistent with evidence of Alexander [1986] and Jarrell & Poulsen [1987]). Differential voting rights of stock and the purchase of shares by a firm's ESOP provide ways for managers to increase voting power at low personal cost.

7. Omitted topics and further references

With its focus on the transaction process, this essay has not addressed in detail the reasons that mergers and acquisitions occur. Some value-improving motives for takeovers include scale economies and complementarities, and remedying inefficient target management behavior. Some reasons for value-reducing takeovers include bidder agency problems, bidder overconfidence, and redistribution of wealth from target securityholders or other stakeholders. Hirshleifer [1993b] reviews these issues and provides references.

I have by no means exhausted the application of economic theories of bargaining and of auctions to takeover modelling. Spatt [1989] provides an insightful survey that deals further with these issues. When target management has the power to reject a bidder, there is room for bargaining over the price. If delay is costly, there is pressure on both sides to reach agreement. This suggests the application of a Rubinstein-type model of bargaining between a bidder and a target in which an alternating sequence of offers determines the division of gains [see Tiemann, 1985; Berkovitch & Narayanan, 1990]. Bulow & Klemperer [1993] examine the expected-price-maximizing choice between selling the company in an English auction versus negotiating with a bidder, and find that under mild conditions the public auction is superior. When the valuations of different competing bidders contain a common component, auction theory suggests a need for bidders to shade their offers downward to account for the winner's curse effect; see the evidence of Giliberto & Varaiya [1989].

Takeover threats can influence the behavior of a firm's top executives and its board of directors. Top executives may be forced to work harder, or may make investment or other operating decisions which are unprofitable but make the firm appear successful temporarily. A growing literature on such managerial reputational concerns has been stimulated by Holmstrom [1982]; for a recent review, see Hirshleifer [1993a]. Takeover markets can also interact with internal supervision by boards of directors, because arrival or nonarrival of a bid conveys information about how potential bidders view the manager [see Hirshleifer & Thakor, 1994].

8. Conclusion

Certain central ideas emerge from the models discussed here:

1. *The free-rider problem in tender offers.* A free-rider problem occurs among shareholders of a tender offer target whose value can be improved by the bidder. This occurs because an individual shareholder does not take into account that tendering his shares to the bidder increases the expected wealth of the other shareholders and the bidder. Since the free-rider problem encourages shareholders to retain their shares, it leads to higher prices in successful tender offers, and deters potential bidders. In the extreme case, a bidder cannot capture any of the takeover surplus. Free-riding is more severe if shareholders are small, hence less likely to be individually pivotal in determining the success or failure of an offer (Grossman & Hart [1980]; but see Bagnoli & Lipman [1988] and Holmstrom & Nalebuff [1992]), and if a bidder can revise his offers [Harrington & Prokop, 1993].

2. *The effect of noise on the likelihood of shareholders being pivotal.* Models in which shareholders overcome the free-rider problem are based on tendering strategies that are coordinated so that each shareholder has a substantial probability of being pivotal. It was conjectured that this degree of coordination may not be possible when plausible noise is added in the form of a fraction of the shareholders who are influenced by costs and benefits that are not observed by the others. Thus, there remains reason to expect the free-rider problem to be effective.

3. *Means of profit in tender offers.* Despite the free-rider problem, there exist means by which a value-improving bidder can profit in a tender offer. First, the bidder can succeed at a price below post-takeover value if he has a credible threat to dilute the post-takeover value of nontendered shares [Grossman & Hart, 1980]. Second, the improvement in target value will increase the value of shares owned by the bidder or accumulated secretly prior to the offer [e.g., Shleifer & Vishny, 1986; Kyle & Vila, 1991; Chowdhry & Jegadeesh, 1994]. However, in many tender offers, profits derived from initial shareholdings do not justify the costs of bidding.

4. *Adverse selection among targets.* A disadvantage of cash tender offers is that there is an adverse selection problem arising from the information possessed by targets of merger bids: they will accept offers that are too generous, and reject offers that are too stingy [Hansen, 1987]. This leads to a problem of efficiency as well as distribution, because potential bidders may be deterred from making offers, and because targets may accept offers even when their information indicates that the takeover will not increase underlying value [Fishman, 1989].

5. *Offer success and informational superiority of the bidder.* Informational superiority does not necessarily benefit the bidder, because this increases the skepticism of the target about the adequacy of the offer in comparison with the post-takeover value the bidder can generate. Thus, an informational advantage of the bidder can cause offer failure, and steps taken to reduce asymmetry of information can increase the probability of offer success [Hirshleifer & Titman, 1990].

6. *Communication and structuring of offers.* The terms of takeover bids (level of bid and the choice of means of payment) communicate part or all of the bidder's information about the target, and can be designed to mitigate inefficiencies that arise from informational advantages of the bidder or target [e.g., Hansen, 1987; Fishman, 1988, 1989; Hirshleifer & Titman, 1990; Berkovitch & Narayanan, 1990; Eckbo, Giammarino & Heinkel, 1990]. Communication occurs through both the level of the bid and the means of payment chosen. A high offer generally indicates high valuation, because it indicates that the bidder places high value on increasing his probability of success. The use of equity rather than cash indicates low valuation, because of adverse selection problems with equity issuance [Myers & Majluf, 1984]. Payment with equity makes the target partake in the bidder's gains and losses, so that overpayment by the bidder can be limited and the target's information can be exploited in determining whether the takeover will be completed.

7. *Information costs, bid costs and the efficiency of auction outcomes.* Costs of investigation and of bidding cause takeover auctions to proceed by a few jumps

rather than many small increments, and can reduce the expected price at which the target is sold. The advantage of increasing the bid substantially is that this can communicate a high valuation, inducing a competitor to withdraw. Since both investigation and costs of bid revision limit the information conveyed in the auction process, the winner need not be the bidder with highest valuation of the target [e.g., Fishman, 1988, 1989; Bhattacharyya, 1992; Hirshleifer & Png, 1990; Daniel & Hirshleifer, 1993]. The conventional analysis of competitive takeover auctions based on zero bid costs is extremely delicate; very different results emerge with positive but small costs. This is because in a costly auction, as information is communicated a bidder withdraws as soon as he believes he will lose; this can occur at an offer level well below the lowest bidder valuation.

8. *Ambiguous nature and effects of managerial defensive strategies*. Certain measures ordinarily regarded as defensive can promote bidder success by reducing asymmetry of information, and by driving the price up to a level that encourages shareholders to tender [Hirshleifer & Titman, 1990]. Most target defensive measures and takeover regulations imposed upon bidders have theoretically ambiguous effects on the expected price paid and efficiency, because they (i) drive up price, (ii) cause failure, (iii) deter investigation of targets by initial bidders, and (iv) sometimes encourage competition by higher valuation bidders (numerous papers).

9. *Managerial voting rights as a takeover defense*. Target managerial control of voting rights provides a defense against tender offers by reducing the pool of voting shares available for purchase by the bidder [Harris & Raviv, 1988; Stulz, 1988]. It therefore affects whether a rival for control will attempt a tender offer, a merger bid or a proxy fight (Harris–Raviv).

10. *The effect of target capital structure on managerial voting power*. Managerial control of voting rights and the fraction of gains appropriated by the bidder are influenced by target capital structure and other corporate decisions. A debt-for-equity exchange in which managers do not participate will increase managers' fractional equity holdings [Harris & Raviv, 1988; Stulz, 1988]. Thus, capital structure can be used as a strategic device to position the firm to absorb takeover gains.

11. *Other uses of capital structure as a device for strategic positioning*. A bidder can position himself to bid aggressively by adjusting his debt levels or his initial shareholdings in the target, deterring potential competitors [Chowdhry & Nanda, 1993; Burkart, 1994]. A target can issue risky debt so that a value improvement effected by takeover will accrue partly to its debtholders rather than the acquirer [Israel, 1991].

I will conclude by mentioning three directions for further research. A problem that will require a combination of analytics and empiricism is to select among various possible explanations why bidders on average pay such high premia [see Nathan & O'Keefe, 1989; and Berkovitch and Narayanan, 1991], and why average combined bidder-target equityholder value gains from takeover appear to be so large. (The much-noted phenomenon of high average target abnormal stock returns associated with takeover is of course a result of the high premia paid.)

A second direction is to explore the consequences of bid costs for the analysis of competitive bidding when there are management defensive measures, and when there is strategic commitment through capital structure or bidder share ownership. Our understanding of these topics is based on models in which bidding is costless (except possibly for the initial bid), and the first bidder's valuation is imperfectly revealed by his bid. In these models bidders ratchet up price a little at a time, instead of the large jumps in price actually observed in most takeovers. Auction outcomes in such settings will be sensitive to the inclusion of arbitrarily small bid costs. Thus, more realistic assumptions about bid costs are likely to lead to different conclusions about various corporate control issues.

A third direction is to explore more thoroughly the consequences of strategic target management behavior, in contrast with the passive or mechanistic assumptions of many models. It would be interesting to study the most dangerous competitor to a takeover bidder, the target management itself. Target management can use inside information about target value and potential improvements either indirectly, by encouraging a white knight (friendly) acquirer to make an offer, or directly by making an offer to purchase the company in a leveraged buyout. It seems possible that the threat of target management competition with potential bidders could be so intense that the feasibility of buyouts would *decrease* aggregate takeover activity, and the disciplinary power of takeover threats.

Appendix: Pivotality and bidder profits

Proof of Proposition 7. Let shareholder i own fraction θ_i of the target. Let v_R be the target firm value if a given shareholder retains her shares, for given actions by the other shareholders, and let v_T be the firm value if she tenders her shares. Let Π^i_S be the gain to a shareholder from tendering her share fraction given the actions of all other shareholders, i.e., the difference in the share value if he retains her shares $\theta_i v_R$ and her revenue if she tenders (bid price b, if her share is purchased; $\theta_i v_R$ if not). Let Π^i_B be the profit made by a bidder from his transaction with given shareholder i, i.e., zero if the shareholder retains her share, zero if the shareholder tenders but her share is not purchased, and the difference between the bid price and v_T if the share is purchased. The shareholder will not tender unless $E[\Pi^i_S] \geq 0$.

I will show that as the probability that any shareholder is pivotal becomes small, the bidder's expected profits can be reduced below any given positive ϵ,

$$E\left[\sum_i \Pi^i_B\right] < \epsilon. \tag{33}$$

Thus, for a sufficiently low probability that shareholders are pivotal, if there is any positive bidding cost, no bid will occur. In obtaining this 'sufficiently low' probability, we are allowing the ownership distribution (number of shareholders and sizes of θ_i's) to vary. I now verify that the tendering condition implies the no-bid condition (33). $\Pi^i_S = 0$ unless the shareholder actually sells her share, in which case $\Pi^i_S = \theta_i(b - v_R)$. The bidder's profit from the shareholder Π^i_S is zero unless the shareholder sells her share, in which case it is $\theta_i(v_T - b)$. Hence, the sum $\Pi^i_B + \Pi^i_S$ is zero if the shares are not purchased, and is $\theta_i(v_T - v_R)$ if they are. Taking the expectation over the probability distribution of the equilibrium actions of the other players and summing over i, and recalling that the θ_i's sum to 1,

$$E\sum_i [\Pi^i_B] = \Pr(\text{Sale})\, E\big[v_T - v_R \mid \text{Sale}\big] - E\left[\sum_i \Pi^i_S\right]. \tag{34}$$

As the probability that shareholder i is pivotal becomes arbitrarily small,

$$E\big[v_T - v_R \mid \text{Sale}\big] \to 0, \tag{35}$$

because $v_T = v_R$ unless the shareholder is pivotal. Since the target shareholder expected profit is nonnegative, it follows that the bidder's expected gross profit is arbitrarily close to zero. Therefore he never makes an offer. □

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