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Signaling in Tender Offer Games[*]

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Abstract

We examine whether a bidder can use tender offer terms to signal post-takeover security benefits. Neither restricted bids nor cash-equity offers allow the bidder to reveal private information. Since atomistic shareholders extract all the gains in security benefits, signaling equilibria are subject to a constraint that is absent from bilateral trade models: The bidder must enjoy gains from trade that are excluded from bargaining (private benefits) but can nonetheless be relinquished. Dilution, debt financing, and toeholds are viable signaling devices because they imply private benefits that depend on security benefits in a predictable manner. In these signaling equilibria, lower-valued types must forgo a larger fraction of their private gains, and these costs can prevent some takeovers. Strikingly, the separation of cash flow and voting rights overcomes the asymmetric information problem. Offers that include derivatives allow for a complete separation and can therefore implement the symmetric information outcome.

JEL Classifications: G32

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1   Introduction

In a tender offer, a bidder invites dispersed shareholders to sell their shares at a specified price. Tender offers have three distinct features: First, they involve a transfer of two goods, cash flow rights and voting rights. Second, the sellers face a collective action problem, since they do not coordinate their tendering decisions. Third, the information advantage is on the buyer's side. The bidder has identified the target and devised restructuring plans, whereas dispersed shareholders seldom possess information that is not already impounded in the stock price. To succeed, the bidder therefore has to convince target shareholders that the offer price is adequate.

This paper presents a comprehensive analysis of the question of whether a bidder can use the offer terms to signal private information about the post-takeover share value to dispersed shareholders. Our negative result is that this is impossible in the standard tender offer game with non-transferable private benefits of control. Our positive result is that signaling equilibria emerge under two sets of conditions. On the one hand, a subset of bidders can reveal their type if they can relinquish their private benefits in a manner that is informative about the post-takeover share value. On the other hand, the asymmetric information problem can be resolved if bidders are allowed to unbundle cash flow and voting rights. In fact, the use of derivatives can replicate the outcome under symmetric information.

We begin by revisiting the standard tender offer game in which the bidder is privately informed about the target's post-takeover security benefits and enjoys exogenously given private benefits of control. In this setting, an impossibility result obtains: The bidder cannot reveal her type through the offer terms. Neither restricted bids nor cash-equity offers are viable signals, which stands out against findings from bilateral merger models (e.g., Eckbo et al., 1990). The result exposes a fundamental conflict between incentive compatibility and collective action problem. The incentive compatibility constraints require that high-valued bidders who have an incentive to mimic low-valued types earn information rents. Yet, the collective action problem precludes that these rents stem from gains in security benefits; dispersed shareholders do not tender unless the offer price matches at least the post-takeover share value, since they perceive their individual decision as negligible for the tender offer outcome (Grossman and Hart, 1980; Bradley, 1980).

To explore possibilities for signaling, we extend the game in two directions. The first extension allows the bidder to relinquish (part of) her private benefits. Signaling equilibria exist, provided that the bidder can commit to relinquishing her private benefits and can do so in a manner that enables shareholders to infer the post-takeover security benefits. One contribution of this paper is to identify this as a signaling mechanism that can be

implemented through a variety of devices, including dilution, toeholds, and debt financing. All these devices allow the bidder to choose how much of the takeover surplus to withhold from target shareholders, and the shareholders to infer the post-takeover security benefits. Specifically, the bidder can signal low security benefits by committing to dilute minority shareholders less, choosing a smaller toehold, or raising less debt finance. While each of these measures reduces her private benefits, they allow her to succeed at a lower price.

Signaling equilibria that rely on relinquishing private benefits have drawbacks. First, since lower-valued bidders must give up more private benefits, the equilibrium outcomes typically exhibit inefficiencies at the "bottom." In equilibrium, only bidders above a cut-off type make a bid, and a lower cut-off type amounts to more takeover activity. Second, the equilibria are not robust to the introduction of additional private information. When the bidder also has more information about her private benefits, signaling becomes infeasible. Essentially, relinquishing a given fraction of private benefits is no longer a viable signal because target shareholders cannot infer how costly such an offer is for the bidder.

Another finding is that bid restrictions, though either insufficient or redundant as a signal, promote takeover activity. This is because smaller transaction sizes mitigate the asymmetric information problem. With fewer traded shares, a bidder gains less from paying a price below the post-takeover share value. Since this reduces the incentives to mimic, lower-valued bidders need to sacrifice fewer private benefits to reveal their type. The positive effect of bid restrictions could be exploited more if majority *control* did not require majority *ownership*. Deviating from this requirement amounts to separating cash flow and voting rights.

The second extension therefore allows for methods of payment other than cash or equity. Indeed, we demonstrate that the use of non-voting shares or financial derivatives can generate equilibria that completely eliminate the impact of asymmetric information. These financial instruments allow the bidder to buy the target shares for cash, strip the shares of their voting rights, repartition the cash flow rights, and reissue only those parts she wants to shed. The bidder can use the first steps to gain control, and the last steps to self-impose penalties for underpaying. In particular, call options enable target shareholders to seek "damages" from the bidder if the security benefits turn out to be larger ex post than professed ex ante. This makes the price de facto contingent on the post-takeover security benefits, thereby overcoming the information asymmetry.

This security design solution separates ownership and control and intentionally allocates part of the upside to outside investors. In doing so, it prevents frictions in the cash flow trade from spilling over to the vote trade and credibly reveals a low valuation. As we show, the intuition behind this solution also applies to shareholder activism and the accumulation of voting rights in secondary markets (empty voting). The general point is that (partially)

separating control and ownership can help prevent asymmetric information problems from interfering with efficient control allocation. This contrasts with standard corporate finance models, where the optimal design typically allocates both ownership and the upside to the party in control (Jensen and Meckling, 1976; Innes, 1990; Leland and Pyle, 1977; Myers and Majluf, 1984).

Our analysis yields several testable predictions. First, the use of cash-equity offers should be less pronounced in tender offers than in negotiated mergers. Moreover, the use of cash as a means of payment should be less strongly correlated with takeover gains in tender offers than in negotiated mergers. Second, the signaling equilibria that rely on private benefits suggest that, across tender offers, voluntary governance restrictions by the bidder, less leverage (in bootstrap acquisitions), and smaller toeholds should be associated with lower takeover premia. Third, bidders avoid overpaying for the target by offering option-like securities such as convertibles, especially when target shareholders feel they are at an informational disadvantage and are concerned about being underpaid.

The tender offer game with a privately informed bidder is a corporate finance application of the informed principal problem (Maskin and Tirole, 1990), with the added feature that the uninformed party suffers from a free-rider problem. The interaction of information asymmetry and the free-rider problem makes tender offers distinct from the standard bilateral trade setting. One-sided asymmetric information does not affect the bilateral trade outcome when the informed party makes a take-it-or-leave-it offer. This is not true in tender offer games due to the free-rider problem.

Grossman and Hart (1981) and Shleifer and Vishny (1986) offer the first analyses of asymmetric information in tender offers. Both papers focus exclusively on pooling equilibria. Hirshleifer and Titman (1990) and Chowdry and Jegadeesh (1994) are the only papers that construct separating equilibria in a tender offer game. These equilibria require shareholders to randomise their decision such that bids at lower prices fail with higher probability. As we demonstrate in Sections 3.1.4 and 3.1.5, these equilibria are applications of the general signaling mechanism identified in this paper. Marquez and Yilmaz (2008) reverse the information asymmetry and study a tender offer game in which target shareholders receive private information signals so that the bidder faces a "winner's curse" problem, as opposed to a signaling problem. To the best of our knowledge, we present the first systematic study of signaling in tender offer games.[1]

Several papers show that the choice of payment method can overcome asymmetric infor-

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[1] Rather than reducing the information gap between bidder and target shareholders, signaling can also serve the purpose of deterring potential rivals, as in Fishman (1988, 1989), Bhattacharya (1990), and Liu (2008).

mation problems in mergers (Hansen, 1987; Berkovitch and Narayanan, 1990; Eckbo et al., 1990). Importantly, all of these papers consider bilateral negotiations and hence abstract from the free-rider problem. With the exception of Berkovitch and Naranayan (1990), the papers also consider two-sided asymmetric information problems in which target shareholders know more about either the share value under the incumbent manager or the takeover synergies. In other words, the settings differ from ours in precisely those aspects that distinguish tender offers from other control transactions. The same holds true for Brusco et al. (2007) and Ferreira et al. (2007), who study cash-equity bids in a mechanism design framework. The problem these papers examine becomes rather simple under our informational assumptions, since pure cash offers would always implement the full information outcome.

The impossibility of signaling in the standard tender offer game mirrors the result in Nachman and Noe (1994), that competitive pricing among security issuers eliminates all separating equilibria. The free-rider condition is our analogue to the competitive pricing assumption. Our results on the signaling benefits of unbundling cash flow and voting rights are, to a certain extent, anticipated in Marquez and Yilmaz (2006) and At et al. (2007), who explore the impact of supermajority rules and dual-class shares on the pooling equilibrium outcomes of tender offer games with privately informed bidders. These results also complement recent work on empty voting by Brav and Matthews (2009) and Kalay and Pant (2009). Finally, the use of convertible securities as a means of overcoming information asymmetries is also the focus in Finnerty and Yan (2009), who study a bilateral merger setting with two-sided asymmetric information, and Chakraborty and Yilmaz (2009), who revisit the external financing model of Myers and Majluf (1984).

The paper proceeds as follows. The next section analyses the tender offer game with non-transferable private benefits and restricted cash-equity offers. Section 3 studies the game with transferable private benefits. Section 4 demonstrates how the symmetric information outcome can be implemented through the use of derivatives. Section 5 discusses the empirical implications of our analysis. Section 6 presents our concluding remarks, and mathematical proofs are in the Appendix.

2 Non-Transferable Private Benefits

A widely held firm faces a single potential acquirer, henceforth the bidder. If the bidder gains control, she can generate security benefits X. The bidder learns her type prior to making the tender offer, whereas target shareholders merely know that X is distributed on $\mathcal{X} = [0, \overline{X}]$ according to the continuously differentiable density function $g(X)$. The cumulative distribution function is denoted by $G(X)$. If the takeover does not materialise,

the incumbent manager remains in control. The incumbent generates security benefits X^I that are known to all shareholders and normalised to zero. Thus, we restrict attention to the case of value-improving bids.

In addition, control confers exogenous private benefits $\Phi \geq 0$ on the bidder. The private benefits are known only to the bidder and are, for simplicity, a deterministic function of her type.[2] Furthermore, the bidder cannot commit not to extract the private benefits once in control. Since the private benefits accrue exclusively to the bidder, they are de facto non-transferable. Our specification of private benefits can accommodate various sources of bidder gains, such as dilution (Grossman and Hart, 1980) and toeholds (Shleifer and Vishny, 1986). For the sake of notational simplicity, however, we subsequently assume that the bidder has no initial stake.

Since the firm has a one share–one vote structure, a successful tender offer must attract at least 50 percent of the firm's shares. The tender offer is conditional, and therefore becomes void if less than 50 percent of the shares are tendered. In addition, the bidder can restrict the offer to a fraction $r \in [0.5, 1]$ of the shares. For simplicity, we assume that there are no takeover costs. Hence, the benchmark (full information) outcome is that all takeovers succeed.[3]

The timing of the model is as follows. In stage 0, the bidder learns her type X. In stage 1, she then decides whether to make a take-it-or-leave-it, conditional restricted tender offer in cash (alternative means of payment will be considered later). If the bidder does not make a bid, the game moves immediately to stage 3. Otherwise, she offers to purchase a fraction r of the outstanding shares at a price rP.

In stage 2, the target shareholders non-cooperatively decide whether to tender their shares. Shareholders are homogeneous and atomistic. In stage 3, the incumbent manager remains in control if the fraction of tendered shares β is less than 50 percent. Otherwise, the bidder gains control and pays βP unless the offer is oversubscribed, in which case she pays rP, and tendering shareholders are randomly rationed.

If target shareholders could coordinate their tendering decisions, they would accept the offer whenever the price at least matches the security benefits under the incumbent manager. Thus, their reservation price would be independent of the bidder's type, and the bidder would succeed and appropriate the entire value improvement from the takeover. However,

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[2] We analyse the more general case with two-dimensional bidder types later in the paper (see Section 4.2).

[3] As in other tender offer models exploring the free-rider problem, we assume that the firm's outstanding shares of mass 1 are dispersed among an infinite number of shareholders whose individual holdings are both equal and indivisible. When either of these assumption is relaxed, Grossman and Hart's (1980) result that all the gains in security benefits go to the target shareholders becomes diluted (Holmström and Nalebuff, 1992).

since the shareholders are atomistic and decide non-cooperatively, their reservation price depends on the bidder's type. Each shareholder tenders at stage 2 only if the offered price at least matches the expected security benefits. Since shareholders condition their expectations on the offer terms (r, P), a successful tender offer must satisfy the free-rider condition $P \geq \mathrm{E}(X | r, P)$. We assume that shareholders — after observing a bid price P and updating their beliefs — tender unless the price is strictly lower than the expected post-takeover security benefits. This eliminates failure as an equilibrium outcome when the free-rider condition is strictly satisfied.[4]

When the bid price exactly equals the expected post-takeover share value, the target shareholders are strictly indifferent between tendering and retaining their shares. That is, they are indifferent between these actions irrespective of their beliefs about the takeover outcome, so that the weak dominance criterion does not pin down a tendering strategy. The prevalent way of resolving the indeterminacy when $P = \mathrm{E}(X | r, P)$ is to assume that each shareholder tenders in this case, and hence the bid succeeds with certainty.[5] Alternatively, one can assume that strictly indifferent shareholders randomise, and that this leads to a probabilistic outcome.[6] Subsequently, we focus on deterministic outcomes and examine the conditions under which fully revealing equilibria exist in which (some) bidders signal their type through the chosen offer terms. The exception is Section 3.1.5, which considers probabilistic outcomes of the basic model with non-transferable private benefits. Finally, to keep focus on the feasibility of signaling, we abstract from pooling equilibrium outcomes that exist with transferable and non-transferable private benefits.[7]

2.1   Impossibility of Signaling

Under the assumption that each shareholder tenders in case she is strictly indifferent, all shares ($\beta = 1$) are tendered in a successful takeover. Accordingly, a successful restricted

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[4]Given a conditional bid, a shareholder who believes the bid will fail is indifferent between tendering and retaining. Imposing this belief on all shareholders and breaking the indifference in favour of retaining supports failure as an equilibrium, irrespective of the offered price (Burkart et al., 2006). To avoid the co-existence of success and failure as equilibrium outcomes, it is typically assumed that shareholders tender their shares when they are indifferent (e.g., Shleifer and Vishny, 1986). Contrary to our assumption, this precludes failure as the equilibrium outcome for a conditional bid, and hence the existence of an equilibrium when the free-rider condition is violated.

[5]A common motivation for this approach is that the bidder could sway the shareholders by raising the price infinitesimally. Although this argument holds under full information, it does not apply in the asymmetric information setting, as even small price increases affect shareholders' expectations about the post-takeover security benefits.

[6]Judd (1985) shows that a continuum of independent and identically distributed variables can generate a stochastic aggregate outcome.

[7]Pooling outcomes are extensively studied in Shleifer and Vishny (1986), Marquez and Yilmaz (2005) and At et al. (2007).

bid is oversubscribed, and the bidder randomly selects the fraction r among all shareholders whose shares are purchased. The remaining $1 - r$ shareholders cannot sell and become minority shareholders.

The bidder's expected profit from a bid (r, P) is

$$\Pi(r, P) = q(r, P) \left[\Phi(X) + r (X - P) \right],$$

where $q(r, P)$ denotes the success probability, which is equal to 1 for $P \geq \mathrm{E}(X | r, P)$, and 0 otherwise. In a fully revealing equilibrium, the offer terms must be distinct across types that make a (successful) bid. This requires that each equilibrium offer satisfies the free-rider condition, $P(X) \geq X$, and the bidder's incentive compatibility constraint

$$\Phi(X) + r(X) \left[X - P(X) \right] \geq \Phi(X) + r (X - P)$$

for all $r \in [0.5, 1]$ and $P \in \mathbb{R}$.

Theorem 1 *In deterministic tender offer games with non-transferable private benefits, no fully revealing equilibrium exists.*

Given that $P(X) \geq X$, a truthful bidder at best breaks even on the purchased shares, and her expected profit cannot exceed $\Phi(X)$. However, each type offering her actual security benefits cannot be an equilibrium outcome. If a type x were to succeed with an offer rx, any type $X > x$ would mimic type x to acquire shares at a price below their true value X. This also holds if each type were to choose a different bid restriction $r(\cdot)$. Type X's profits are higher when buying $r(x)$ shares at a discount compared to buying $r(X)$ shares at their fair price, whether $r(x)$ is smaller or larger than $r(X)$. These arguments eliminate $P(X) = X$ combined either with a common r or a type-contingent $r(\cdot)$ as possible equilibria. They also rule out outcomes in which some types offer more than their true security benefits but less than the highest-valued type's security benefits. Successful offers with $P(x) \in (x, \overline{X})$ would be mimicked by bidders of type $X > P(x)$. Thus, a bidder can credibly signal her type only by offering a sufficiently large premium such that $P \geq \overline{X}$.

Revealing her type with an offer $P \geq \overline{X}$ is, however, not an attractive option for the bidder.[8] She can instead make a bid $P = \overline{X}$ and restrict it to $r = 0.5$, the minimum fraction

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[8]In fact, an incentive-compatible schedule $\{(r(\cdot), P(\cdot))\}$ can be constructed that entails that lower-valued bidders offer higher (per share) prices but purchase fewer shares. Bidders abstain from mimicking lower-valued types, since they would forgo a larger more valuable equity stake. Conversely, bidders do not mimic higher-valued types because they would have to pay a larger total amount for an equity stake that is worth less.

required to gain control. The less costly offer $(0.5, \overline{X})$ succeeds, since it satisfies the free-rider condition for all types (and any possible shareholder beliefs).

The inexistence result extends to settings where the private benefits are not a deterministic function of the bidder's type but, instead, follow some — possibly type-contingent — density function. Indeed, the constraints in the bidder's maximisation problem are not affected by the non-transferable private benefits. They cancel out in the incentive compatibility constraint and are not part of the free-rider condition.

Also, note that letting bidders choose the fraction of shares that they acquire does not allow them to signal their type. The bid restriction merely limits the fraction of shares the bidder purchases for cash. This makes restricted bids in this setting equivalent to bids in which target shareholders are in part compensated through equity. Indeed, it is immaterial whether the bidder makes a partial bid for cash only or acquires all shares in exchange for some cash and $1 - r$ shares in the target firm under her control. Moreover, control requires that the partial bid be for at least half the shares or that the equity component not exceed the cash component in the cash equity offer. By virtue of this equivalence, any fully revealing equilibrium in cash-equity offers would also have to exist in restricted cash-only offers.

Proposition 1 *Introducing cash-equity offers into deterministic tender offer games with non-transferable private benefits does not make fully revealing equilibria feasible.*

Proposition 1 contrasts with results from bilateral merger models where cash-equity offers can reveal the bidder's type (Hansen, 1987; Berkovitch and Naranayan, 1990; Eckbo et al., 1990).[9] Our basic framework differs in two key respects. First, target shareholders have no private information and face, instead, a collective action problem; that is, they are unable to coordinate their individual tendering decisions.[10] Second, the takeover is not undertaken to combine assets from two firms but to replace the incumbent managers. How or whether the free-rider problem affects signaling equilibria is studied in the next section, while the role of bidder assets will be explored later in the paper (see Section 3.1.3).

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[9]Contrary to negotiated mergers, tender offers are usually cash offers. In fact, the mode of acquisition is one of the most important determinants of the payment method (e.g., Martin, 1996). The standard explanation focuses on regulatory delays associated with equity offers, that is, the greater cost of using equity as a means of payment. Our analysis suggests that means of payment do not help overcome asymmetric information problems in tender offers.

[10]In merger models, the shareholders' reservation price is typically the stand-alone value of the target firm that, although unknown to the bidder, does not depend on her type. An exception is Berkovitch and Narayanan (1990), where the shareholders' outside option is to wait for a competing bid, and this option value depends on the quality of the initial bidder relative to potential competitors.

2.2 Free-Riding and Information Rents

To illustrate the role of the free-rider condition, we digress to a modified setting in which the bidder is able to appropriate part of the security benefits. Abstracting from a specific extensive game form, we assume that the bidder has bargaining power $\omega \in (0,1)$ such that shareholders, if fully informed, would tender their shares at a price $P = (1 - \omega) X$. Accordingly, the bidder would, under full information, appropriate a value improvement ωX on the purchased shares. Like the private benefits Φ, these gains depend on the bidder type and a successful takeover but, unlike the private benefits, the gains are transferable. In other words, the bidder can (commit to) leave part of ωX to the shareholders. A second, purely simplifying modification is the absence of private benefits ($\Phi = 0$).

Given that shareholders do not observe the bidder's type, they condition their beliefs on the offer terms and tender only if $P \geq (1 - \omega) \, \mathrm{E} \, (X \, | r, P)$. Consequently, some bidders may not succeed or may realise less than the full information profit ωX. That is, some bidders may have to offer more than $(1 - \omega) X$ or set $r < 1$ to signal their type, while others may find such signals too costly.

Proposition 2 *In the tender offer game with bidder bargaining power $\omega \in (0,1]$, a fully revealing equilibrium exists. All types above the cut-off type $X^c(\omega) \in [0, \overline{X})$ make a bid, and higher types buy more shares at a higher price and make a larger profit.*

Incentive compatibility requires that higher-valued bidders buy more shares at higher prices. On the one hand, bidders refrain from mimicking lower-valued types because the increase in the profit margin is offset by the smaller fraction of shares that can be bought at lower prices. On the other hand, bidders do not mimic higher-valued types, since buying more shares requires paying a higher price.[11] Lower-valued bidders credibly reveal their type not only by bidding for fewer shares but also by purchasing them at lower relative discounts $|P(X) - X| / X$, thereby having to concede an increasing fraction of their full information profit ωX to the target shareholders. As a consequence, there exists a cut-off type X^c who just breaks even, offering exactly $P = X^c$. Conversely, the highest-valued bidder reaps her full information gains $\omega \overline{X}$ and can purchase all shares at $P = (1 - \omega) \overline{X}$, because target shareholders always tender for $P \geq (1 - \omega) \overline{X}$, irrespective of their beliefs.

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[11] Proposition 2 implies that the bidder faces an upward-sloping supply curve: A larger demand for shares reveals a higher valuation which in turn raises target shareholders' ask price. This is akin to the downward-sloping demand curve that a privately informed issuer meets when selling securities (e.g., DeMarzo and Duffie, 1999). Though contrary to the informed seller setting, gains from trade materialise in tender offers only if the bidder acquires a control stake. Therefore, trade collapses once the incentive-compatible supply of shares is less than 0.5.

Due to the above equivalence (Proposition 1), Proposition 2 can also be phrased in terms of cash-equity offers. In this interpretation, the equilibrium offer schedule entails that higher-valued bidders use more cash and less equity. This is the same result as in the bilateral merger models of Eckbo et al. (1990) and Berkovitch and Narayanan (1990), though there is a subtle difference. In our setting, the bidder wants to signal low rather than high security benefits. This shifts the emphasis from cash as a high-value signal to equity as a low-value signal. Equity is a credible signal for low-valued bidders because relinquishing equity is costlier for high-valued bidders.

The positive relation between equilibrium profits and bidder types in Proposition 2 is a common feature of adverse selection models: Incentive compatibility requires that the types who have incentives to mimic others earn information rents (e.g., Laffont and Martimort, 2002). In our setting, higher-valued bidders receive these rents, and incentive compatibility dictates the rate at which equilibrium profits decrease. Given the slope, the profit levels are determined by the boundary condition $\Pi^*(\overline{X}) = \omega\overline{X}$. That is, the highest type's equilibrium profit determines for which type the incentive-compatible profit falls to 0.

Corollary 1 *As the bidder's bargaining power ω approaches 0, the cut-off type $X^c(\omega)$ converges to $\overline{X}$.*

Corollary 1 brings to light the impact that free-riding behaviour has on the feasibility of revealing offers when private benefits are non-transferable. The subset of bidders who can signal their type without incurring a loss (on the purchased shares) increases in the fraction of the share value improvement that each bidder would be able to appropriate under full information. In other words, as the target shareholders' free-riding behaviour becomes more severe, the bidder's ability to signal her type gradually deteriorates. In the limit ($\omega = 0$), no bidder type is able to make a profit on the purchased shares, and the separating equilibrium breaks down.

It should be noted that separation fails even though the bidder's objective function satisfies the single-crossing property.[12] The impact of the free-rider behaviour on the (in)existence of signaling equilibria can be interpreted in two ways. From the perspective of lower-valued types, the free-rider condition eliminates the possibility of producing a costly signal. Given that target shareholders extract all the gains in security benefits, the bidder cannot surrender (part of) these gains to signal her type. From the perspective of higher-valued types, the free-rider condition wipes out information rents. A bidder who at best breaks even on truthfully purchased shares will always want to mimic a lower-valued type.

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[12] For each fixed (r, P), $-\frac{\partial\Pi/\partial r}{\partial\Pi/\partial P}$ is strictly monotone in X.

3 Relinquishing Private Benefits

The preceding discussion suggests that key to signaling is the existence of bidder gains that are excluded from bargaining (private benefits) but can nonetheless be relinquished in a manner that allows inference about the security benefits. Subsequently, we show that this principle lies beneath the existence of fully revealing equilibria. We first derive it in a general setting and then implement it in well-known variants of the tender offer game in which the bidder can choose how much private gains to appropriate.

3.1 Fully revealing equilibria

Suppose that the bidder can commit to transfer any fraction of her private benefits Φ to the target shareholders, such that she retains a fraction $\alpha \in [0, 1]$. The tender offer is then a triple (r, α, P); it specifies the fraction of shares offered to acquire, the retention rate of private benefits, and the per share cash price. For a given offer, the bidder's payoff from a successful takeover is

$$\Pi(r, \alpha, P; X) = \alpha \Phi(X) + r(X - P). \tag{1}$$

If a signaling equilibrium exists, the equilibrium outcome can also be implemented as a direct (truth-telling) mechanism. Let $\hat{X}$ denote a bidder's self-reported type. The bidder's problem can then be formulated as

$$\max_{\hat{X}} \Pi(\hat{X}; X) = \alpha(\hat{X})\Phi(X) + r(\hat{X})[X - P(\hat{X})],$$

$$
\begin{aligned}
\text{subject to } (a) \quad & r(\hat{X}) \in [0.5, 1] \\
(b) \quad & \alpha(\hat{X}) \in [0, 1] \\
(c) \quad & P(\hat{X}) \geq 0 \\
(d) \quad & r(\hat{X})P(\hat{X}) + [1 - \alpha(\hat{X})]\Phi(\hat{X}) \geq r(\hat{X})\hat{X}
\end{aligned}
\tag{2}
$$

for all $\hat{X} \in \mathcal{X}$, where (d) is the free-rider condition. Under a fully revealing offer schedule $\{r(\cdot), \alpha(\cdot), P(\cdot)\}$, the solution to this problem and hence to its first-order condition

$$r(\hat{X})P'(\hat{X}) = \alpha'(\hat{X})\Phi(X) + r'(\hat{X})[X - P(\hat{X})] \tag{3}$$

must be $\hat{X} = X$ for all $X \in \mathcal{X}$.

Theorem 2 *In tender offer games where bidders can commit to relinquish any fraction of their private benefits, a fully revealing equilibrium exists if $\Phi(\cdot)$ is a non-decreasing function.*

All types above the cut-off type $X^c \in [0, \overline{X})$ make a bid, and higher types relinquish a smaller fraction of their private benefits. The bid restriction is a redundant signal.

Incentive compatibility requires that higher-valued bidders offer higher prices but also retain more of their private benefits. Bidders do not mimic lower-valued types because the gains from paying the lower price are offset by the loss in private benefits. Conversely, bidders refrain from mimicking higher-valued types because the gain from retaining a larger fraction of the private benefits does not compensate for the higher price. Furthermore, since lower-valued types have (weakly) fewer private benefits, this signaling mechanism — relinquishing private benefits — can lead to an *interior* cut-off type $X^c \in (0, \overline{X})$ whose retained private benefits $\alpha(X^c) \Phi(X^c)$ just equal her total takeover premium $r(X^c)[P(X^c) - X^c]$. By contrast, the highest-valued type purchases shares at $P(\overline{X}) = \overline{X}$ and keeps all private benefits $\Phi(\overline{X})$, thus reaping her full information profit.

There exist multiple fully revealing equilibrium schedules. This is most evident from the first-order condition (3), which has two degrees of freedom: One can, for example, freely choose $r(\cdot)$ and $P(\cdot)$ and then determine $\alpha(\cdot)$ to satisfy (3). A natural choice seems to be $r(X) = 1$ and $P(X) = X$. In that case, the bidder offers the full information price, and the takeover premium — that is, the value of the tender offer over and above X — is equal to the forgone private benefits, $[1 - \alpha(X)]\Phi(X)$. This schedule most clearly shows that the signaling cost is ultimately paid out of the bidder's private gains. However, the bidder can also transfer part of these gains by paying a higher price $P(X) > X$. This makes her offer less attractive to mimic, so that she needs to relinquish fewer private benefits. Paying the shareholders through $P(\cdot)$ or relinquishing part of $\Phi(\cdot)$ are therefore substitutes, provided that lower-valued types transfer a sufficiently large fraction of their private gains.

A second source of multiplicity is the freedom of choice with respect to $r(\cdot)$. While the chosen $r(\cdot)$ affects $\alpha(\cdot)$ and $P(\cdot)$ through (3), bid restrictions are a redundant signal in the sense that a fully revealing equilibrium can be supported even when the restrictions are uniform, $r(X) = \overline{r}$. The reason is that signaling is achieved by transferring private benefits, which does not rely on restricting the bid, although bid restrictions are not irrelevant, because they affect the efficiency of the tender offer outcome. We will return to this point in Section 4.1.

The assumption that $\Phi(\cdot)$ is non-decreasing ensures that relinquishing a given fraction of the private benefits is more costly for higher-valued types. It is therefore a sufficient condition to obtain fully revealing equilibria. When $\Phi(\cdot)$ is decreasing or non-monotonic, no general result obtains. One can find examples in which separation is feasible and other examples

in which only pooling equilibria exist.[13] Besides delivering clear-cut results, the assumption that $\Phi(\cdot)$ is non-decreasing is naturally satisfied in common variants of the tender offer game, as we subsequently show.

3.1.1 Dilution

Consider an extended tender offer game in which the successful bidder chooses what fraction ϕ of the firm's total post-takeover value $V \in \mathcal{V}$ to divert as private benefits. In addition, dilution does not dissipate value, so that a successful bid generates security benefits $X(V) = (1-\phi)V$ and private benefits $\Phi(V) = \phi V$.

Diversion as a source of private benefits was first introduced by Grossman and Hart (1980), who assume a uniform dilution rate ϕ. Burkart et al. (1998) endogenise the ex post dilution decision by assuming that diversion dissipates value, so that ϕ is determined by the bidder's post-takeover equity stake. This implies that the bidder can de facto pre-commit to a dilution rate by choosing what fraction of target shares are acquired.

Here, we take a simpler approach and assume that the bidder can commit to not extract more than a fraction $\phi \in [0, \bar{\phi}]$ of V independent of the bid restriction.[14] The upper bound $\bar{\phi} < 1$ is an exogenous limit set by legal shareholder protection, business combination laws, or, more broadly, the corporate governance system.[15] In practice, a takeover activist or private equity fund can include self-imposed constraints in the restructuring plans or in the post-takeover governance structure (e.g., management team or board composition of a special purpose acquisition company) that are announced as part of the takeover proposal. Similarly, the business combination agreement can contain covenants that restrict certain types of post-takeover transactions that would be detrimental to minority shareholders.

The tender offer terms are now given by the triple (r, ϕ, P). If ϕ were uniform across bidder types, the setting would be equivalent to the tender offer game with non-transferable private benefits, in which no separating equilibrium exists. However, since ϕ is a choice variable, Theorem 2 can be implemented.

Application 1 *Limiting dilution is a viable signal. All types above the cut-off type make a bid, and higher types extract a larger fraction of the total firm value as private benefits.*

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[13]For instance, when $\Phi(\cdot)$ is strictly decreasing, no type $X < \overline{X}$ is able to separate from the highest-valued type $\overline{X}$ by paying a lower price and relinquishing a larger share of private benefits, since this offer — if it were preferred by type X over $\overline{X}$'s offer — would be mimicked by $\overline{X}$.

[14]Since the bid restriction is a redundant signal, we could construct fully revealing equilibria where dilution depends on the bidder's equity stake. To this end, $r(\cdot)$ is set to pin down an increasing $\phi(\cdot)$. Given $r(\cdot)$ and $\phi(\cdot)$, $P(\cdot)$ is then chosen to satisfy the first-order condition. That is, the validity of the principle carries over to the inefficient diversion setting of Burkart et al. (1998).

[15]Business combination laws usually prohibit certain kinds of transactions between a large shareholder and the firm for a period of three to five years after the shareholder's stake passes a pre-specified threshold.

To reveal their type, lower-valued bidders relinquish a larger fraction of private benefits by choosing a lower extraction rate. Incentive compatibility requires that both the extraction rate $\phi(\cdot)$ and the bid price $P(\cdot)$ increase with the bidder type. Bidders who dilute more must pay a higher price. Conversely, bidders who pay a lower price must "tie their hands", that is, commit to dilute less. It is as if bidders can buy a larger degree of post-takeover discretion (control) by paying a higher price. This positive relation between dilution and bid premia reflects the signaling role of private benefits. Indeed, in the symmetric information settings of Grossman and Hart (1980) or Burkart et al. (1998), bidders have no incentive to voluntarily dilute less and choose the maximum extraction rate ($\phi = \bar{\phi}$), irrespective of their type.

The cut-off type is decreasing in the overall scope for dilution, which is determined by the quality of the corporate governance system. Better minority shareholder protection (lower $\bar{\phi}$ values) reduces the possibility for bidders to reveal their type by voluntarily constraining their ability to dilute minority shareholders. In parallel to Corollary 1, $V^c(\bar{\phi})$ converges to $\overline{V}$ as $\bar{\phi}$ approaches 0, and the fully revealing equilibrium collapses in the limit. Finally, note that the bidder's maximum private benefits $\Phi(X) = \bar{\phi}X$, which she would extract under symmetric information, are increasing in her type X. That is, $\Phi(\cdot)$ is, by construction, a non-decreasing function.

3.1.2 Debt finance

Müller and Panunzi (2004) show that a leveraged tender offer, in which the bid is partly financed through debt, can implement a takeover outcome that is quite similar to the outcome implemented by dilution. Initially, the bidder sets up a shell company that issues debt backed by claims on the target's assets. She then makes a tender offer for the target shares and, if the bid is successful, merges the acquired firm with the shell company. The fact that the combined firm is indebted lowers its share value, which in turn lowers the bid price at which target shareholders are willing to tender their shares. Such a "bootstrap acquisition" allows the bidder to acquire the target at a lower price, and hence appropriate part of the takeover gains.

Given that leverage functions as a source of private benefits, Theorem 2 suggests that it can also serve as a signaling device. To illustrate this possibility in the simplest fashion, consider the modified type space $\mathcal{X}' = [\underline{X}, \overline{X}]$, where $\underline{X} > 0$. In addition, suppose that the bidder can raise debt up to $D \in [0, \overline{D}]$, where $\overline{D} < \underline{X}$ is an exogenously imposed limit. Thus, the tender offer terms are now given by the triple (r, D, P).

Application 2 *Debt financing is a viable signal. All types above the cut-off type make a bid, and higher types raise more debt.*

Application 2 showcases the general principle with less leverage corresponding to relinquishing more private benefits. Bidders do not mimic lower-valued types because the gains from purchasing the shares at a discount are offset by the decrease in leverage. Conversely, bidders do not mimic higher-valued types because the higher leverage is offset by the larger premium they would have to pay for the shares. In equilibrium, more expensive takeovers go together with a larger amount of debt finance. The maximum possible amount of debt $\Phi(X) = \overline{D}$, which bidders would raise under symmetric information, is constant across bidder types. That is, $\Phi(\cdot)$ is again a non-decreasing function. Similarly to before, the cut-off type is decreasing in $\overline{D}$, and takeover activity — absent other signaling devices — vanishes as $\overline{D}$ approaches 0, that is, as debt finance "dries" up.[16]

3.1.3 Bidder assets

The canonical tender offer game abstracts from bidder assets other than cash. When owning assets $A > 0$, the bidder could use claims to such assets to pay target shareholders, and the willingness to do so might reveal her type. Theorem 2 suggests that the viability of such signals requires that the bidder assets appreciate in value as a result of the takeover, and that this appreciation be non-negatively correlated with the value improvement in the target firm. In addition, these synergy gains must be exclusionary in that they do not accrue to non-tendering target shareholders and, as such, do not affect their reservation price (free-rider condition). In this sense, they are equivalent to private benefits.

Suppose that the bidder owns cash and a firm that generates security benefits $Z + \lambda X$ if the bid succeeds, and λX otherwise. Both the value $Z \geq 0$ and the parameter $\lambda > 0$ are commonly known and are the same for all types. If the bidder is successful, she combines the two firms in a holding company H. Target shareholders are offered a cash price $C(\beta)$ and $s(\beta)$ shares in the holding company, where β denotes the fraction of target shares tendered. Furthermore, target shareholders are cash-constrained, and the bidder is unwilling to relinquish majority control of the holding company. These assumptions impose two restrictions on the set of admissible offers, a *cash* constraint $C(\beta) \geq 0$ and a *control* constraint $s(\beta) \in [0, 0.5]$.

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[16] A thorough analysis of leverage as a signaling device in tender offers should, of course, relax the constraint $\overline{D} < \underline{X}$ and, more importantly, account for insolvency risks and financial distress costs, as in the more general framework of Müller and Panunzi (2004). We simply want to point out that bidders can use leverage as a means to reveal private information about the post-takeover share value to free-riding shareholders. Osano (2009) also analyses the role of leverage in a tender offer game with private information but primarily focuses on pooling equilibria. In fact, the signaling incentives we describe here do not arise under Osano's model assumptions.

Application 3 *Sharing exclusionary synergy gains is a viable signal. All types above the cut-off type make a merger bid, and lower types pay more in the equity of the merged company.*

The cash price C and the fraction of shares s that target shareholders receive in equilibrium are inversely related. Bidders who give target shareholders a larger fraction of the post-merger equity pay a smaller amount of cash. Even though λX is perfectly correlated with X, the mere fact that the bidder assets are informative about the post-takeover share value is neither necessary nor sufficient to obtain a fully revealing equilibrium. The key is that the bidder assets appreciate in value as a result of the takeover, that is, the bidder enjoys the exclusionary gains Z. Relinquishing (more) post-merger equity is a means of sharing (more of) these private benefits. Accordingly, the cut-off type is decreasing in Z, and takeover activity — again, absent other signaling devices — vanishes as Z approaches 0. Note also that the value of the gains the bidder would retain under symmetric information is $\Phi(X) = Z + \lambda X$ and increasing in her type.

The cash-equity equilibrium offers in Application 3 are similar to those found in the aforementioned means-of-payment literature. Though contrary to bilateral merger models, tender offer games with bidder assets do not require two-sided asymmetric information to generate a role for cash-equity offers. It is enough that the bidder have private information about the post-takeover value improvement in the target. As we will show in Section 3.2, this signaling equilibrium collapses when the bidder has additional private information about the value of her assets.

3.1.4 Toehold acquisition

Another source of bidder gains, first studied by Shleifer and Vishny (1986), are equity stakes that the bidder acquires prior to the tender offer (toeholds). Suppose that the bidder can purchase up to a fraction $\bar{t}$ of the target shares in the open market — for simplicity, at the price of $P = X^I$ — before having to make her takeover intentions public. The upper bound $\bar{t}$ represents a mandatory disclosure, or mandatory bid, rule that prevents the bidder from acquiring an even larger pre-bid stake in the target.

Application 4 *Toeholds are a viable signal. All types above the cut-off type make a bid, and higher types acquire larger toeholds.*

The signaling potential of endogenous toeholds has already been analysed within a probabilistic tender offer game by Chowdhry and Jegadeesh (1990) (we turn to the probabilistic tender offer game below). Our analysis shows that toeholds as a signal are one implementation of the general principle, and that they do not rely upon probabilistic outcomes.

3.1.5 Probabilistic outcomes

Here we revisit the tender offer game with non-transferable private benefits (see Section 2). Contrary to before, we assume that shareholders randomise their tendering decision if they are strictly indifferent after having observed the bid price P and updated their beliefs. This assumption generates probabilistic outcomes when the offered price exactly matches the expected security benefits. Otherwise, shareholders either always or never tender their shares. Given an offer $P = E(X \,|\, r, P)$, the success probability $q(r, P)$ can lie anywhere in $[0, 1]$, and the expected fraction of acquired shares $\gamma(r, P)$ can lie anywhere in $[0.5, r]$. The bidder's expected profit from a bid (r, P) is therefore

$$\Pi(r, P) = q(r, P) \left[\Phi(X) + \gamma(r, P) \, (X - P) \right].$$

Application 5 *In the probabilistic tender offer game with non-transferable private benefits, a fully revealing equilibrium exists if $\Phi(\cdot)$ is a non-decreasing function. All types make a bid, and higher-valued types are more likely to succeed.*

In equilibrium, a lower-valued bidder pays a lower price but her bid is less likely to succeed. The higher failure rate protects her bid from being mimicked by higher-valued types. Importantly, this deterrence effect *exclusively* operates through the risk of losing *private* benefits. In fact, if $\Phi(\cdot) = 0$ or even if merely $\Phi(\overline{X}) = 0$, the signaling equilibrium breaks down.

Revealing bids with probabilistic outcomes are but another illustration of Theorem 2. The specific feature is that bidders do not signal their type through conceding private benefits to the shareholders but, rather, through burning private benefits by way of failure. As in the other applications, the outcome is inefficient: While all types actually make a bid in equilibrium, bids do not always succeed. Furthermore, the bid restriction remains a redundant signal and there are multiple equilibrium schedules. Hirshleifer and Titman (1990) select a schedule where all types restrict their bid as much as possible ($r = 0.5$).

3.2 Another Impossibility of Signaling

Theorem 2 and its applications demonstrate how crucial private benefits are to the bidder's ability to signal. However, their existence is merely a necessary but not sufficient condition. The bidder must also be able to relinquish private benefits in a manner that is *informative*. More specifically, the target shareholders must be able to evaluate how costly a given signal is to the bidder, or the signal may not be sufficiently credible.

To examine the informativeness of private benefits, we abandon the assumption that the bidder's security benefits perfectly predict her private benefits (i.e., that Φ is a deterministic function of X). Instead, we assume that the bidder types are *two*-dimensional, (X, Φ), and continuously distributed on $[\underline{X}, \overline{X}] \times [\underline{\Phi}, \overline{\Phi}]$. The bidder is informed about both dimensions of her type. In contrast, the target shareholders know neither how much a particular bidder will improve the share value nor how much she values control. The setting is otherwise the same as in Theorem 2. For expositional convenience, we characterise the tender offer terms by the triple (r, α, C) where $C \equiv rP$.

Theorem 3 *In tender offer games with two-dimensional bidder types, no fully revealing equilibrium exists, even when bidders can commit to relinquishing any fraction of their private benefits.*

Signaling breaks down in the two-dimensional case because the private information about Φ undermines the credibility of the retention rate α (i.e., the relinquishing of private benefits) as a signal. Since Φ is not a deterministic function of X, target shareholders cannot infer from the offer (r, α, C) how costly it is for a bidder to concede $1 - \alpha$ of her private benefits. The uncertain relation between Φ and X jams the signal. Theorem 3 thus weakens the case for fully revealing equilibria that rely on the use of the bidder's private benefits as a means of revealing information about the security benefits.[17]

Whether private benefits Φ are (un)informative about the security benefits X depends on the specific setting. In the case of dilution, toeholds, or leverage, the relation between private benefits and security benefits is relatively well defined by the "extraction" technology. Hence, we would argue that Φ being a deterministic function of X seems a reasonable approximation. By contrast, it seems more plausible that bidder assets are at least to some extent unrelated to the target assets, and that the bidder has additional private information about the value of her assets. Theorem 3 thus challenges the robustness of the signaling equilibrium in mergers (Application 3), reinforcing the conclusion from Proposition 1 that cash-equity offers appear to be a less effective signaling device in tender offers than in bilateral negotiations.

4   Separating Votes and Cash Flows

In the above signaling equilibria, lower-valued bidders must relinquish more private benefits. As a result, some low-valued bidders either refrain from bidding or are more likely to fail. This raises the question to what extent the tender offer can be designed to improve the efficiency of the equilibrium outcome.

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[17]Pooling equilibria also exist in the case of two-dimensional bidder types (Burkart and Lee, 2010).

4.1 Efficiency of Restricted Bids

We address this issue in the framework with one-dimensional bidder types and transferable private benefits (see Section 3.1). While the bid restriction r is a redundant signal in this setting, it affects the cut-off type and hence takeover activity.

Theorem 4 *In tender offer games where bidders can commit to relinquish any fraction of their private benefits and $\Phi(\cdot)$ is a non-decreasing function, restricting bids promotes (more) takeover activity.*

Bid restrictions promote takeover activity because smaller transaction sizes mitigate the asymmetric information problem: With fewer traded shares, a bidder gains less (in total) from paying a price below the post-takeover share value. This reduces the incentives to mimic low-valued bidders, so that these types do not need to sacrifice as many private benefits to credibly reveal small security benefits. Thus, more restricted bids translate into lower signaling costs. This argument implies that the most efficient equilibrium is achieved when all types restrict their bid as far as possible ($r = 0.5$). As in Theorem 2, this result applies to the different variants of the tender offer games studied in Section 3.1.

In essence, Theorem 4 says that efficiency is *de*creasing in the fraction of shares traded.[18] Thus, unlike in other trade models with asymmetric information, quantity rationing is not an inefficient outcome but a means of mitigating trade inefficiency. This counterintuitive result obtains because the gains from trade in tender offers are contingent on the transfer of votes, rather than the transfer of cash flow rights, as in security issues.[19]

4.2 Dual-Class Offers

A share (trade) represents a (trade of a) bundle of two goods with potentially distinct values. This defining feature of tender offer games suggests an alternative perspective on the asymmetric information problem: Value-improving control transfers are impeded because control must be transferred in conjunction with potentially misvalued cash flow rights. Hence, efficiency would be further improved if the bidder could gain majority control without acquiring a majority stake, that is, if she could separate votes and cash flows to prevent the informational frictions of the cash flow trade from spilling over into the vote trade.[20]

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[18] At et al. (2007) show that Theorem 4 also holds in pooling equilibrium outcomes.

[19] This is not true if the bidder's incentives to improve the target value vary with her post-takeover stake. Separating cash flow and voting rights can, in this case, be beneficial, even in the absence of asymmetric information (Burkart et al., 1998).

[20] For this reason it can be both socially and privately optimal for target shareholders to adopt a dual-class share structure (At et al., 2007).

Perhaps the most straightforward way to unbundle control and ownership is to make a dual-class security exchange offer. The bidder offers to exchange each of the target's voting shares against a non-voting share. Shareholders accept the bid, since it preserves their fraction of the cash flow rights. By construction, the bidder pays exactly the post-takeover security benefits to gain control. This replicates the full information outcome without revealing the bidder's type.

Despite resolving the asymmetric information problem, the dual-class offer is problematic because it leaves all cash flow rights with the shareholders. That is, the bidder has no equity interest in the firm after the takeover. On the one hand, this makes the offer equivalent to a simple replacement of management, which begs the question of why a takeover is necessary in the first place. On the other hand, it makes the offer prone to abuse by value-decreasing bidders (or fly-by-night operators), since it does not require the bidder to put up any cash (Bebchuk and Hart, 2001). Cash payments put at least some (lower) bounds on the bidder's quality.

4.3   Options

Value-increasing bids fail as bidders are not — or only to a limited extent — willing to pay for cash flows that they know do not exist. This problem can also be resolved by a cash offer combined with securities that leave the non-existing cash flows to target shareholders. In the present setting, call options provide this solution. It merely requires that every type $X \in \mathcal{X}$ purchases a target share in exchange for cash $P(X) = X$ and a (cash-settled) call option with an exercise price of $S(X) = X$.

Proposition 3 *Offers with call options allow one to implement the full information outcome.*

If a type X were to succeed with an offer $x < X$, she would pay a cash price x for shares that are worth X. However, ex post she would not capitalise on this gain, since the target shareholders would exercise their options once the actual value improvement became known. Conversely, the low-valued type does not mimic the high-valued type, because she would pay X for shares that are worth x. Thus, the offer schedule is incentive-compatible. Moreover, every bidder succeeds, irrespective of how many shares are acquired or whether any private benefits are enjoyed.

Financial engineering enables the bidder (i) to trade economic ownership void of voting rights and (ii) to issue contingent claims. The first step of the transaction consists of acquiring the target shares and stripping them of their votes. In the second step, the bidder re-issues

the cash flow rights, restructured into claims that punish her for lying about the security benefits. The call options that are executed when the post-takeover security benefits are higher than professed penalise the pretence of low security benefits — ex post when the true value is observed. This makes the offer equivalent to the simplest solution to the asymmetric information problem: a bid price that is contingent on the post-takeover share value.

The above offer transfers, cash aside, only future claims but no actual future cash flows to target shareholders. This is an artefact of the assumption that the post-takeover security benefits X are deterministic (i.e., perfectly known by the bidder). Yet, the main intuition carries over to a setting with stochastic cash flows. Let $X \in [0, \infty]$ be a random variable. Suppose that there are n bidder types $\theta \in \Theta \equiv \{1, 2, \dots, n\}$, each knowing the probability density function $f_\theta(X)$ of her post-takeover cash flows. In addition, we assume that the family of densities $\{f_\theta(X)\}_{\theta \in \Theta}$ satisfies the strong monotone likelihood ratio property (SMLRP). That is, for all $\theta' > \theta$, $f_{\theta'}(X)/f_\theta(X)$ is strictly increasing.

To construct a fully revealing equilibrium, we allow the bidder to pay cash and issue bonds and barrier options.[21] The barrier option used to construct the equilibrium is a (cash-settled) knock-in (or up-and-in) call option. This is a latent call option with an exercise price of S that becomes activated only once the security benefits X exceed some trigger level $T > S$. When exercised, these options dilute the value of the firm's equity. To simplify the exposition, we further assume that $\Phi = 0$.

Proposition 4 *In the tender offer game with stochastic post-takeover security benefits, a fully revealing equilibrium exists if SMLRP holds. All bidder types make a bid and purchase the target shares for a combination of cash, bonds, and knock-in call options.*

The security design solution in Proposition 4 provides sellers with both upside participation and downside protection. The bidder primarily wants to signal a low value. To this end, she issues knock-in options that transfer some high cash flow realisations to the target shareholders. However, the use of knock-in options makes the bidder prone to being mimicked by (even) lower-valued types. To remove doubts about the value of the offered options, she must include bonds to separate from lower-valued types. Thus, the bidder's need to separate from lower-valued types through offering downside protection *derives endogenously* from the bidder's *primary* intention to distinguish herself from higher-valued types by offering upside participation.

It is worth comparing the results with the existing literature on security design. In tender offers, separating ownership and control as well as conceding the upside to non-controlling

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[21] A barrier option is a derivative where the option to exercise depends on the (price of the) underlying crossing or reaching a given barrier level.

investors can improve the control allocation. The former prevents frictions in the cash flow trade from spilling over into the vote trade, while the latter allows bidders to effectively signal a low valuation. This contrasts with the conclusions from both moral hazard models, where retaining ownership and the upside improves the controlling party's incentives (Jensen and Meckling, 1976; Innes, 1990), and external financing models, where retaining ownership and the upside signals a high valuation (Leland and Pyle, 1977; Myers and Majluf, 1984).

4.4   Shareholder Activism and Empty Voting

The insight that the separation of cash flow and voting rights mitigates asymmetric information problems is not confined to tender offers. It also applies to negotiated control transfers or trades in secondary markets. This is perhaps best illustrated by adapting the present model to the case of an activist investor who has superior information about the value consequences of a shareholder proposal. Suppose the investor already owns a minority stake α in a firm and faces an uninformed market-maker in the secondary market. The investor knows that the proposal, if approved, increases the security benefits from the current 0 to X. As in Brav and Matthews (2009), the voting process is noisy and the investor can increase the probability that the proposal is approved by acquiring more voting shares. Let $q(r)$ denote the approval probability and r the fraction of voting shares acquired in the open market, with $q'(r) > 0$ and $q(0) = 0$.

To meet the investor's buy order, the market-maker has to go short in the stock, which exposes her to price risk. For a given r, the market-maker is willing to take the short side of the transaction if $P \geq q(r) X$. The problem is that, unlike the activist investor, the market-maker does not know the true value of X. As in the tender offer game, the buyer (investor) must therefore convince the seller (market-maker) that the transaction price is adequate.

One can construct a signaling equilibrium with market orders r or limit orders (r, P). In either case, the r-P-schedule has to satisfy the same incentive compatibility constraints. Defining $\Phi(X) \equiv \alpha X$, the investor maximises the objective function

$$\Pi(r, \alpha, P) = q(r) \left[\Phi(X) + r \left(X - P \right) \right],$$

which has the same structure as in the probabilistic tender offer game (see Section 3.1.5). That is, we can apply Theorem 2 and the intuition underlying the probabilistic signaling equilibrium to the activist investor example. When the potential value improvement is small, the investor buys fewer shares at a lower price, and the proposal is less likely to be approved. The high failure rate justifies the lower price, since it prevents mimicking from higher-valued

types. This deterrence effect operates through the risk of forgoing the value improvement of the initial stake α. In effect, the investor is more eager to buy more voting shares when larger value improvements are at stake in the shareholder vote.

As in Proposition 3, unbundling cash flow and voting rights can implement the efficient symmetric information outcome. In principle, the investor could offer to buy $(0.5 - \alpha)$ voting shares at the price $P = X$ and simultaneously enter a derivative contract to go short in $(0.5 - \alpha)$ call options with strike price X. This would allow the investor to purchase sufficient voting shares to ensure that the proposal is accepted. Strikingly, the derivatives position of the activist investor represents a bet against the firm. This negative interest is a prerequisite for buying the shares at the fair price, that is, for acquiring the attached voting rights at no (additional) cost. A transaction to the same effect is to borrow voting shares to register more votes on the record date. Our results suggest that such empty voting can improve corporate decisions and, hence, increase firm value, consistent with the evidence in Christofferson et al. (2007).

Of course, unbundling can prove problematic if the investor wishes to push through a proposal that would decrease the firm's share value ($X < 0$). Such incidences are documented in, for example, Hu and Black (2006, 2008), and similar situations are modeled in Brav and Matthews (2009). As Hu and Black point out, increased disclosure of economic ownership and vote control at the time of the vote should reduce such incidences.

5   Empirical Implications

Due to the free-rider problem, signaling in tender offers is rather different from signaling in bilateral merger negotiations. This is most evident in our finding that cash-equity offers are much less likely to provide the signaling benefits that they are associated with in the merger literature (see Proposition 1 and Theorem 3).

Prediction 1 The use of all-cash or cash-equity offers should be less pronounced in tender offers than in negotiated takeovers (mergers).

Prediction 2 The proportion of cash used as a means of payment should be less strongly correlated with takeover gains in tender offers than in negotiated takeovers (mergers).

The basic problem in models of bilateral merger negotiations under asymmetric information is a lemon's problem, namely, that informed parties are prone to *over*state the value of their assets. In contrast, privately informed bidders in tender offers have an incentive to *under*state the value of their assets. One way for the bidder to credibly reveal a lower value is

to share more of her private gains from trade, provided that it allows the uninformed target shareholders to infer the true value (see Theorem 2). Common to such signaling equilibria is the prediction that takeover premia should be positively correlated with the fraction of the takeover surplus that the bidder extracts as private benefits (hereafter, relative private benefits). By comparison, in the absence of asymmetric information, bidders would appropriate the maximum possible amount of private benefits. In this case, bid premia and the bidder's relative private benefits are either unrelated (in the case of dilution or toeholds) or inversely related (in the case of leverage).

Since private benefits are difficult to measure directly, empirical tests of the relation between takeover premia and private benefits have to rely on proxies for private benefit extraction.

Prediction 3 Across tender offers, takeover premia should be positively correlated with fewer voluntary governance restrictions for the bidder, greater amounts of bidder debt in bootstrap acquisitions, or larger toehold sizes.

It should be noted that bidder governance, toeholds, and leverage can also be driven by other factors, such as free cash flow problems (Jensen, 1986) or bidding competition (e.g., Chowdhry and Nanda, 1993). Some of these effects can work in the opposite direction. For instance, if larger toeholds deter potential rival bidders, toehold size and takeover premia can be negatively correlated (e.g., Betton et al., 2008). Because our predictions pertain to the resolution of asymmetric information, we expect the predicted relations to be strongest in the subset of tender offers in which the bidder appears to have a large informational advantage.

There exist only few empirical studies on the role of debt finance in takeovers. Schlinge-mann (2004) finds no significant relation between the amount of debt financing before a takeover announcement and bidder gains. In contrast, Martynova and Renneboog (2009) find that debt financing is associated with positive valuation effects, that is, represents a positive signal to investors.[22] For a more in-depth analysis of the effects of takeover leverage, one should, however, discriminate between tender offers and negotiated mergers, contested and uncontested tender offers, and bootstrap and non-bootstrap acquisitions.

Another way for bidders to signal their true value is to include contingent claims in their tender offer (Propositions 3 and 4). To placate target shareholders' fears of being short-changed, bidders must include claims that become effective if (and only if) the post-takeover value turns out to be higher than professed at the time of the offer. One example of such claims is convertible bonds.

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[22]See also Betton et al. (2008).

Prediction 4 To avoid overpaying, bidders offer option-like claims that pay off in case the target's post-takeover performance exceeds a certain threshold.

There are a few empirical studies on the use of derivative securities in control transactions. Gaugham (2002) describes a wide range of derivatives used in mergers and acquisitions, including claims that provide sellers with both downside *and* upside protection. Officer (2004) studies the use of collars in mergers and Finnerty and Yan (2009) study convertibles. The reported evidence supports the idea that acquirers use derivatives to mitigate asymmetric information problems.

6   Conclusion

This paper analyses tender offers in which a single bidder is better informed about the post-takeover share value than dispersed target shareholders. Two key features of the tender offer process render this situation very different from standard bilateral trade models. First, free-riding shareholders have full bargaining power over the value improvement in the target shares, even though the better-informed bidder makes a take-it-or-leave-it offer. Second, the parties in a tender offer bargain over both control (voting rights) and over ownership (cash flow rights) in the target firm. That is, unlike other signaling models in finance, a share (trade) represents a (trade of a) bundle of two goods with potentially distinct values.

We demonstrate that these differences lead to constraints, as well as solutions, that are absent in bilateral trade models. Because the bidder is forced to concede all gains in share value to the shareholders, she cannot signal her type by *voluntarily* giving up such gains. Neither restricted bids nor cash-equity offers are therefore viable signals in tender offers. Instead, the bidder must enjoy private benefits that are not only excluded from bargaining but can also be forgone in a manner that allows inference about the post-takeover share value. This is never possible when the bidder has additional private information about the private benefits, as in the case of two-dimensional bidder types. In the one-dimensional case, relinquishing private benefits is a viable signal, as long as they depend on the security benefits in a predictable manner. Dilution, debt financing, or toeholds can serve this purpose. The underlying principle in all cases is the same: The bidder must forgo (more) private benefits to signal a low(er) type. Unfortunately, some low-value bidders can find it too costly to signal their type, even if the takeover would be efficient.

Such inefficiencies can be overcome if the bidder can include derivatives in the tender offer terms. Derivatives allow the bidder to separate cash flow rights from voting rights. This separation prevents the information problems in the trade of cash flow rights from spilling

over into, and thereby impeding, the trade of voting rights. As a result, control can be transferred efficiently, irrespective of any potential disagreement between the bidder and the target shareholders about the value of the post-takeover cash flow rights.

Our analysis has implications for the design of takeover bids. For instance, it suggests that derivatives as a means of payment are an effective signaling device in takeovers, while cash-equity offers should play a less prominent role in tender offers than in negotiated mergers. Furthermore, acquiring firms can signal their quality through self-imposed restrictions on post-takeover decisions or through the amount of takeover leverage. The main theoretical contribution of this paper is to study how the interaction of asymmetric information and collective action problems, in a specific market setting, can bear on the optimal design of a trade contract. There are situations other than tender offers in which such interactions are potentially important, as in, for example, renegotiations with dispersed bondholders.

Proofs

Proof of Proposition 1

Proposition 1 follows from the equivalence of mixed offers and restricted cash-only offers which the subsequent lemma establishes. Consider a bid for r shares that offers a cash price C and t shares in the post-takeover firm.

Lemma 1 *Under full information, the restricted mixed offer (r, C, t) and the restricted cash-only offer (r^{co}, C^{co}) with $C^{co} = C$ and $r^{co} = r - t$ are payoff-equivalent.*

Proof. To succeed, the mixed offer must satisfy the free-rider condition $C + tX \geq rX$, or equivalently

$$C/r + (t/r) X \geq X. \tag{4}$$

Given the condition is satisfied, all shareholders tender, and the bidder's payoff is

$$\Phi(X) + r [X - (C/r + (t/r) X)]. \tag{5}$$

Rearranging the free-rider condition (4) to

$$C \geq (r - t) X$$

and the bidder's payoff (5) to

$$\Phi(X) + (r - t) X - C$$

shows that the restricted cash-*only* offer (r^{co}, C^{co}) with $C^{co} = C$ and $r^{co} = r - t$ is payoff-equivalent for any X. ∎

Hence, if a fully revealing equilibrium in mixed offers were to exist, a fully revealing equilibrium in cash-only offers would also exist. As Theorem 1 rules out the latter, a mix of cash and equity is not a viable signal. ∎

Proof of Proposition 2

We first characterize properties of an incentive-compatible r-P-schedule.

Lemma 2 *In a fully revealing equilibrium, $r(\cdot)$, $P(\cdot)$ and $\Pi(\cdot)$ must be increasing.*

Proof. Without loss of generality, consider an arbitrary pair of types, X and x with $X > x$. A fully revealing schedule $\{(r(\cdot), P(\cdot))\}$ must satisfy the non-mimicking constraints

$$r(X) [X - P(X)] \geq r(x) [X - P(x)] \quad \text{for } (x, X) \in \mathcal{X}^2. \tag{6}$$

We show by contradiction that (6) requires $r(X) > r(x)$. The non-mimicking constraints for type X and x are

$$C(X) - r(X)X \le C(x) - r(x)X \quad \text{and} \quad C(x) - r(x)x \le C(X) - r(X)x \qquad (7)$$

where $C(\cdot) \equiv r(\cdot)P(\cdot)$. For $r(X) = r(x)$, the inequalities hold jointly only if $C(X) = C(x)$, and hence $P(X) = P(x)$, in which case the two offers would be identical. For $r(X) < r(x)$, rewrite (7) as

$$C(x) \ge C(X) + [r(x) - r(X)]X \quad \text{and} \quad C(x) \le C(X) + [r(x) - r(X)]x.$$

Since $C(X) + [r(x) - r(X)]X > C(X) + [r(x) - r(X)]x$, the constraints cannot hold jointly. Thus, the non-mimicking constraints are violated unless $r(\cdot)$ is increasing.

Given $r(X) > r(x)$, condition (6) implies that the bid price and the bidder's profit must also be increasing in her type. To this end, we rewrite (7) as

$$r(X)[X - P(X)] \ge r(x)[X - P(x)] \quad \text{and} \quad \frac{r(X)}{r(x)}[x - P(X)] \le x - P(x).$$

Given that $r(X)/r(x) > 1$, the second inequality implies $P(X) > P(x)$. Furthermore, as $r(x)[X - P(x)] > r(x)[x - P(x)]$, the first inequality implies $r(X)[X - P(X)] \ge r(x)[x - P(x)]$. Thus, higher types must pay higher prices and make higher profits. ∎

Local Optimality. Lemma 2 states necessary conditions for incentive-compatibility. To derive a particular schedule, we assume that $r(\cdot)$ and $C(\cdot)$ are continuously differentiable functions, and rephrase the bidder's optimization problem as a direct truth-telling mechanism:

$$\max_{\hat{X} \in \mathcal{X}} \left\{ r(\hat{X})X - C(\hat{X}) \right\}. \qquad (8)$$

In equilibrium, the first-order condition must hold at $\hat{X} = X$, i.e.

$$r'(X)X = C'(X). \qquad (9)$$

Quasi-concavity. Condition (9) is sufficient to ensure incentive-compatibility if the objective function in (8) is quasi-concave (and out-of-equilibrium beliefs are suitably chosen). Substituting (9) into the derivative of the objective function gives

$$\frac{\partial}{\partial \hat{X}} \left[r(\hat{X})X - C(\hat{X}) \right] \Big|_{C'(\hat{X}) = r'(\hat{X})\hat{X}} = r'(\hat{X})X - r'(\hat{X})\hat{X} = r'(\hat{X})(X - \hat{X}).$$

Given that $r'(\cdot) > 0$ (Lemma 2), it follows that the derivative switches sign for all types $X \in (0, \overline{X})$ once (from positive to negative), and the objective function is strictly quasi-concave.

Cut-off type. Condition (9) puts a constraint on how equilibrium profits $\Pi^*(X) = r(X)X - C(X)$ vary across types. By the envelope theorem,

$$\frac{\partial \Pi^*(X)}{\partial X} = \underbrace{r'(X)X - C'(X)}_{=0} + r(X) = r(X). \tag{10}$$

That is, the marginal change in profits is given by the bid restriction $r(X)$.

Given that bidders have bargaining power ω, shareholders always tender at the price $P = (1 - \omega)\overline{X}$. As type $\overline{X}$ buys shares below their true value, she buys all shares and makes a profit $\Pi^*(\overline{X}) = \omega\overline{X}$. Since profits decrease at the rate $r(X)$ (condition (10)), the cut-off type X^c, making zero profits, is defined by

$$\int_{X^c}^{\overline{X}} r(u)du = \omega\overline{X}. \tag{11}$$

Out-of-equilibrium beliefs. The proposed schedule can be supported as a signaling equilibrium with out-of-equilibrium beliefs that any deviation comes from the highest-valued bidder type $\overline{X}$. Under these beliefs, the target shareholders do not tender their shares in response to a deviation bid $(\tilde{r}, \tilde{P})$ unless $\tilde{P} \geq (1 - \omega)\overline{X} = P(\overline{X})$. Consider two cases. (i) For bidder types $X \in [P(\overline{X}), \overline{X}]$, the deviation bid $(\tilde{r}, P(\overline{X}))$ would yield a positive profit. Yet, it is dominated by the $(r(\overline{X}), P(\overline{X})) = (1, P(\overline{X}))$, the equilibrium bid of the highest type, which we know to be mimicking-proof. Hence, by implication, the deviation is unattractive to these types. (ii) For bidder types $X \in [0, P(\overline{X}))$, the deviation bid would yield a loss and is therefore unattractive to these types. ∎

Proof of Corollary 1

From the definition of the cut-off type (equation (11)), it follows that $\partial X^c / \partial \omega < 0$ and $\lim_{\omega \to 0} X^c = \overline{X}$. ∎

Proof of Theorem 2

Given that $\Phi'(\cdot) \geq 0$, there exists a schedule $\{\alpha(\cdot), r(\cdot), P(\cdot)\}$ with $\alpha' > 0$, $r' \geq 0$ and $P' > 0$ that can be supported as a fully revealing equilibrium.

Quasi-concavity. Suppose that the proposed schedule satisfies (3) for all $X \in \mathcal{X}$. This

schedule then satisfies quasi-concavity of the objective function. Specifically, we show that

$$\partial\Pi/\partial\hat{X} = \alpha'(\hat{X})\Phi(X) + r'(\hat{X})[X - P(\hat{X})] - r(\hat{X})P'(\hat{X}) \tag{12}$$

is non-negative when $\hat{X} \leq X$ and non-positive when $X \geq \hat{X}$.

Condition (3) implies that

$$r(\hat{X})P'(\hat{X}) = \alpha'(\hat{X})\Phi(\hat{X}) + r'(\hat{X})[\hat{X} - P(\hat{X})].$$

Substituting the right-hand side into (12) and rearranging yields

$$\partial\Pi/\partial\hat{X} = \alpha'(\hat{X})\left[\Phi(X) - \Phi(\hat{X})\right] + r'(\hat{X})\left[X - \hat{X}\right]. \tag{13}$$

The assumption $\Phi'(\cdot) \geq 0$ implies that $\Phi(X) \geq \Phi(\hat{X})$ when $\hat{X} \leq X$ and that $\Phi(X) \leq \Phi(\hat{X})$ when $\hat{X} \geq X$. Given that $\alpha' > 0$ and $r' \geq 0$, it follows that

$$\partial\Pi/\partial\hat{X} \text{ is } \begin{cases} \text{non-negative} & \text{for } \hat{X} < X \\ 0 & \text{for } \hat{X} = X \\ \text{non-positive} & \text{for } \hat{X} > X \end{cases}.$$

Thus, the proposed schedule makes $\Pi(\hat{X}; X)$ weakly quasi-concave for all $X \in \mathcal{X}$. This also holds for $r'(\hat{X}) = 0$, in which case all bidder types propose the same bid restriction.

Local optimality. Condition (3) is a functional equation for $\alpha(\cdot)$, $r(\cdot)$ and $P(\cdot)$ with *two degrees of freedom*. To derive an example of an incentive-compatible schedule, we set $r(\cdot) = 0.5$. Then, condition (3) simplifies to

$$\alpha'(X) = \frac{P'(X)}{2\Phi(X)}.$$

Integrating on both sides over $[X, \overline{X}]$ yields

$$\int_X^{\overline{X}} \alpha'(u)du = \int_X^{\overline{X}} \frac{P'(u)}{2\Phi(u)}du \quad \Leftrightarrow \quad \alpha(\overline{X}) - \alpha(X) = \int_X^{\overline{X}} \frac{P'(u)}{2\Phi(u)}du.$$

As the highest-valued type does not have to relinquish any private benefits $[\alpha(\overline{X}) = 1]$,

$$\alpha(X) = 1 - \int_X^{\overline{X}} \frac{P'(u)}{\Phi(u)}du. \tag{14}$$

One possible price schedule is $P(X) = X$ in which case $\alpha(X) = 1 - \int_X^{\overline{X}} [\Phi(u)]^{-1} du$. As

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shareholders receive $P(X) + [1 - \alpha(X)]\,\Phi(X)$, the free-rider condition is also satisfied.

Cut-off type. The condition (3) puts a constraint on how equilibrium profits vary across types in equilibrium. By the envelope theorem, we have that equilibrium profits must be increasing at the rate

$$\partial\Pi^*/\partial X = \alpha(X)\Phi'(X) + r(X),$$

for *any* schedule that satisfies (3).

Given an equilibrium exists, the cut-off type X^c is given by

$$\int_{X^c}^{\overline{X}} \{\alpha(u)\Phi'(u) + r(u)\}\,du = \Phi(\overline{X}). \tag{15}$$

Under the proposed equilibrium schedule, bidder types below X^c incur a loss under the proposed schedule. Hence, they prefer *not* making a bid over making the bid prescribed by the proposed schedule. The option of notmaking a bid does not undermine the non-mimicking constraints. Under the proposed schedule, the bidder prefers a loss-making offer to offers made by higher-valued types. A fortiori, she also prefers a zero-profit offer over the latter.

Out-of-equilibrium beliefs. The proposed schedule can be supported as a signaling equilibrium under the out-of-equilibrium beliefs that any deviation comes from the highest-valued bidder type, $\overline{X}$. Under these beliefs, the target shareholders do not tender their shares in response to a deviation bid $(\tilde{r}, \tilde{\alpha}, \tilde{P})$ unless $\tilde{P} \geq \overline{X}$. Any such bid, however, is weakly dominated by $(0.5, 1, \overline{X})$, which is the equilibrium bid of the highest type. Since $(0.5, 1, \overline{X})$ is mimicking-proof, any successful deviation bid is—by implication—unattractive under the proposed out-of-equilibrium beliefs.

Bid restriction. The above proves that the bid restriction r is a redundant signal. This follows because, as we have shown, the schedule

$$\{r^*(X), \alpha^*(X), P^*(X)\} = \begin{cases} \left\{0.5, 1 - \int_X^{\overline{X}} [\Phi(u)]^{-1}\,du, X\right\} & \text{for } X \in [X^c, X] \\ \{0, 0, 0\} & \text{for } X \in [0, X^c) \end{cases}$$

can, among others, be supported as a fully revealing equilibrium.

By contrast, the private benefit retention rate α and the price P are indispensable as signals. First, if α is invariant across types, Theorem 1 applies. Second, a uniform price in a fully revealing equilibrium must satisfy $P = \overline{X}$. But then all bidder types $X < \overline{X}$ prefer the offer $(0.5, 1, \overline{X})$, which always succeeds irrespective of shareholder beliefs, to any other offer with $P = \overline{X}$. Hence, they would pool. ∎

Application 1

Given bidder of type $V \in \mathcal{V}$ can choose $\phi \in [0, \bar{\phi}]$, she solves

$$\max_{\hat{V}} \phi(\hat{V})V + r(\hat{V})\left[(1 - \phi(\hat{V})V) - P(\hat{V})\right]$$

Set $r(\hat{V}) = r$, express ϕ as $\bar{\phi}\psi$ with $\psi \in (0,1)$, and the objective function simplifies to

$$\bar{\phi}\psi(\hat{V})V + r\left[(1 - \bar{\phi}\psi(\hat{V})V) - P(\hat{V})\right]$$
$$= \bar{\phi}\psi(\hat{V})V + r\left[(1 - \bar{\phi})V - P(\hat{V}) + (1 - \psi(\hat{V}))\bar{\phi}V\right]$$
$$= \left[\psi(\hat{V}) + r(1 - \psi(\hat{V}))\right]\bar{\phi}V + r\left[(1 - \bar{\phi})V - P(\hat{V})\right]$$

This last expression is isomorphic to (1) when using the definitions $X \equiv (1-\bar{\phi})V$, $\bar{\phi}V \equiv \Phi(X)$ and $\alpha \equiv \left[\psi(\hat{V}) + r(1 - \psi(\hat{V}))\right]$. Note that $\bar{\phi}V$ is increasing in the bidder's type. ■

Application 2

Given bidder of type $\mathcal{X}' \in [\underline{X}, \overline{X}]$ can choose $D \in [0, \bar{D}]$, she solves

$$\max D(\hat{X}) + r(\hat{X})\left[X - D(\hat{X}) - P(\hat{X})\right]$$

Set $r(\hat{X}) = r$, express D as $\bar{D}\psi$ and rewrite the objective function as

$$\bar{D}\psi(\hat{X}) + r\left[X - \bar{D}\psi(\hat{X}) - P(\hat{X})\right]$$
$$= \bar{D}\psi(\hat{X}) + r\left[X - \bar{D} - P(\hat{X}) + (1 - \psi(\hat{X}))\bar{D}\right]$$
$$= \left[\psi(\hat{X}) + r(1 - \psi(\hat{X}))\right]\bar{D} + r\left[X - \bar{D} - P(\hat{X})\right]$$

This last expression is isomorphic to (1) when using the definitions $\bar{D} \equiv \Phi(X)$ and $\alpha \equiv \left[\psi(\hat{X}) + r(1 - \psi(\hat{X}))\right]$. Note that $\bar{D}$, i.e., $\Phi(\cdot)$, is constant across bidder types. ■

Application 3

Denote the value of the bidder assets by $A(\mathbb{I}, X) \equiv \mathbb{I}_{\beta \geq 0.5}Z + \lambda X$. The indicator function $\mathbb{I}_{\beta \geq 0.5}$ takes the value 1 if the bid succeeds and 0 otherwise. If the bid succeeds ($\beta \geq 0.5$), the holding company is worth $H(\beta, X) = A(1, X) + \beta X$. Under full information, shareholders do not tender unless $C(\beta) + s(\beta)H(\beta, X) \geq X$. To ensure a successful merger ($\beta = 1$), the

bidder must choose $s(\beta)$ and $C(\beta)$ such that

$$s(\beta) \geq \frac{X - C(\beta)}{Z + \beta X + \lambda X} \tag{16}$$

for all $\beta \in [0.5, 1]$. In this case, all shareholders tender their shares whenever they believe that more than half the shares are tendered, and the bidder must ultimately pay $C(1)$ and $s(1)$. To simplify the exposition, we omit β and express the bidder's offer as a pair (s, C) which must satisfy the free-rider condition for $\beta = 1$, i.e., $s \geq (X - C)/(Z + X + \lambda X)$.[23] Note that condition (16) violates neither the cash constraint nor the control constraint if $C(\beta)$ is chosen sufficiently high.

For a given cash price C and equity component s, the bidder's profit from a successful merger is therefore

$$\Pi(X) = (1 - s)H(1, X) - C - \lambda X = (1 - s)Z + (1 - s)\left(X - \frac{s\lambda X + C}{1 - s}\right).$$

Now define $\alpha \equiv 1 - s$, $r = \alpha$, $\Phi(X) = Z$, and $P = \frac{s\lambda X + C}{1-s}$. The bidder can use s to adjust α and r, and she can use C to adjust P. From Theorem 2, it follows that α must be increasing which in turn implies that s must be decreasing. The constraint $\alpha = r$ results from the fact that the bidder merges the firms and pays the target shareholders with holding company shares.

In this setting, the cut-off type is not necessarily determined by the participation constraint ($\Pi \geq 0$). As lower types issue more equity, they may also run either into the control constraint $s(\cdot) \leq 0.5$ or into the cash constraint $C(\cdot) \geq 0$. The latter may occur because the bidder can in principle become a net *issuer*, rather than a net purchaser, of financial claims. The cash constraint is relevant for bidders for whom A is very large relative to X. Notwithstanding, the participation constraint becomes binding as Z decreases. In particular, $Z = 0$ is equivalent to $\Phi(X) = 0$, and hence causes signaling breaks down. (It is straightforward to verify that using λX (instead of Z) as the synergy gains leads to similar results; in particular, signaling breaks down when $\lambda = 0$.) ∎

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[23]Even without a contingent offer, there exists a self-fulfilling equilibrium in which the merger succeeds for (C, t) as long as it satisfies the free-rider condition for $\beta = 1$: If each shareholder believes that all other shareholders tender, she also tenders. Hence, once can alternatively focus on non-contingent offers, and select merger success as the equilibrium outcome whenever it is consistent with the free-rider condition.

Application 4

The bidder can choose $t \in [0, \hat{t}]$ and solves

$$\max t(\hat{X})X + r_t(\hat{X})(1 - t(\hat{X})) \left[X - P(\hat{X}) \right]$$

with $r_t \in \left[\frac{0.5-t}{1-t}, 1 \right]$. Set $r_t(\hat{X}) = r_t$, express t as $\bar{t}\psi$ and rewrite the objective function as

$$\bar{t}\psi(\hat{X})X + r_t(1 - \bar{t}\psi(\hat{X})) \left[X - P(\hat{X}) \right]$$
$$= \left[\psi(\hat{X}) + r_t(1 - \psi(\hat{X})) \right] \bar{t}X + r_t \left[X - P(\hat{X}) \right]$$

This last expression is isomorphic to (1) when using the definitions $\bar{t}X \equiv \Phi(X)$ and $\alpha \equiv \left[\psi(\hat{X}) + r(1 - \psi(\hat{X})) \right]$. Note that $\bar{t}X$, i.e., $\Phi(\cdot)$, is increasing in the bidder's type. ∎

Application 5

The objective function in the probabilistic tender offer game is:

$$\Pi(r, P) = q(r, P) \left[\Phi(X) + \gamma(r, P)(X - P) \right]$$
$$= \alpha \Phi(X) + \hat{r}(X - P)$$

where $\alpha \equiv q(r, P)$ and $\hat{r} \equiv q(r, P)\gamma(r, P)$. The last expression is isomorphic to (1), except that $\hat{r}$ can take values below 0.5. Provided that $\Phi(\cdot)$ is a non-decreasing function, Theorem 2 can thus be applied. ∎

Proof of Theorem 3

Consider the type $(\overline{X}, \underline{\Phi})$ and an arbitrary type $(X, \Phi) \neq (\overline{X}, \underline{\Phi})$. In any fully revealing equilibrium, type $(\overline{X}, \underline{\Phi})$ cannot be held to a profit lower than $\underline{\Phi}$ because she can always succeed with the bid $(r, 1, r\overline{X})$. At the same time, she cannot earn more than $\underline{\Phi}$ because of the free-rider condition. In order for type $(\overline{X}, \underline{\Phi})$ not to mimic type (X, Φ), the latter type must make an offer (r, α, C) which satisfies $\underline{\Phi} \geq r\overline{X} + \alpha\underline{\Phi} - C$, or equivalently

$$C \geq \underline{C} \equiv r\overline{X} - (1 - \alpha)\underline{\Phi}. \tag{17}$$

In addition, a truthful offer by (X, Φ) must also yield a higher profit than the "out-of-equilibrium" offer $\left(0.5, 1, 0.5\overline{X} \right)$ which succeeds irrespective of target shareholder beliefs.

That is, her offer (r, α, C) must satisfy $rX + \alpha\Phi - C \geq 0.5(X - \overline{X}) + \Phi$, or equivalently

$$C \leq \overline{C} \equiv (r - 0.5) X + 0.5\overline{X} - (1 - \alpha)\Phi. \tag{18}$$

The constraints (17) and (18) are simultaneously satisfied if $\overline{C} \geq \underline{C}$ holds. Straightforward manipulations yield $(r - 0.5)\left(X - \overline{X}\right) \geq (1 - \alpha)(\Phi - \underline{\Phi})$. This condition is violated, unless all types with $X < \overline{X}$ make the pooling offer $\left(0.5, 1, 0.5\overline{X}\right)$. ∎

Proof of Theorem 4

We show that every implementable level of takeover activity can also be implemented by a schedule with $P(X) = X$ and $r'(X) = 0$ (step 1) and that minimizing r promotes takeover activity (step 2).

Step 1. Consider an equilibrium schedule which implements a cut-off type X'. This type satisfies $\Pi(X'; X') = \alpha(X')\Phi(X') + r(X')[X' - P(X')] = 0$. Keeping the cut-off type constant, we maintain the zero-profit condition by setting $\alpha(X') = 0$ and $P(X') = X'$.

This provided, the *same* cut-off type can also be characterized by

$$\Phi(\overline{X}) - \alpha(X')\Phi(X') = \Phi(\overline{X})$$
$$\alpha(\overline{X})\Phi(\overline{X}) - \alpha(X')\Phi(X') = \Phi(\overline{X})$$
$$[\alpha(u)\Phi(u)]_{X'}^{\overline{X}} = \Phi(\overline{X})$$
$$\int_{X'}^{\overline{X}} \{\alpha(u)\Phi'(u) + \alpha'(u)\Phi(u)\}\, du = \Phi(\overline{X}) \tag{19}$$

where we use the fact that $\alpha(\overline{X}) = 1$.

Next, recall that (15) characterizes a unique cut-off type X^c for any equilibrium schedule,

$$\int_{X^c}^{\overline{X}} \left\{\alpha(\hat{X})\Phi'(\hat{X}) + r(\hat{X})\right\} d\hat{X} = \Phi(\overline{X}), \tag{20}$$

and consider an equilibrium schedule which specifies $P(X) = X$ and $r(X) = r(X')$. Under this schedule, the first-order condition (3) becomes $r(X') = \alpha'(\hat{X})\Phi(\hat{X})$. Substituting $r(X') = r(\hat{X}) = \alpha'(\hat{X})\Phi(\hat{X})$, equation (20) becomes equation (19), and $X^c = X'$.

Step 2. Given step 1, we can restrict our attention to schedules with $P(X) = X$ and $r(X) = r$. Under these schedules, the bidder's equilibrium profit is

$$\Pi^*(X) = \alpha(X)\Phi(X).$$

When $\alpha\left(\cdot\right)$ declines at a lesser rate, bidder profits deteriorate slower, as the type decreases. Using conditon (3), $P'(X) = 1$ and $r'(X) = 0$, the slope of $\alpha\left(\cdot\right)$ is

$$\alpha'(X) = \frac{r}{\Phi(X)}$$

and is increasing in r for any $X \in \mathcal{X}$. That is, bidder profits deteriorate at a lesser rate and the cut-off type is lower when r is smaller. $\blacksquare$

Proof of Proposition 4

We first establish the following two auxiliary results.

Lemma 3 *For all $\theta' > \theta$, there exists a unique $X_\theta(\theta') \in (0, \infty)$ s.t.*

$$f_\theta(X) \begin{cases} > f_{\theta'}(X) & \text{for all } X < X_\theta(\theta') \\ < f_{\theta'}(X) & \text{for all } X > X_\theta(\theta') \end{cases}.$$

Proof. By SMLRP, for all $\theta' > \theta$, there is a unique $X_\theta(\theta') \in (0, \infty)$ s.t.

$$f_{\theta'}(X)/f_\theta(X) \begin{cases} < 1 & \text{for } X < X_\theta(\theta') \\ = 1 & \text{for } X \in \mathcal{X}\left(\theta, \theta'\right) \\ > 1 & \text{for } X > X_\theta(\theta') \end{cases}.$$

Otherwise, if $f_{\theta'}(X)/f_\theta(X)$ is either always larger or always smaller than 1, it cannot be that $F_\theta(\infty) = F_{\theta'}(\infty)$. This implies the result. $\blacksquare$

Lemma 4 *For all $\theta'' > \theta' > \theta$, $X_{\theta'}(\theta'') \geq X_\theta(\theta')$.*

Proof. Suppose to the contrary that

$$X_{\theta'}(\theta'') < X_\theta(\theta'). \qquad (\bigstar)$$

By Lemma 3, it then follows that

(a) For $X \in (0, X_{\theta'}(\theta''))$: $\quad \frac{f_{\theta''}(X)}{f_{\theta'}(X)} < 1$ and $\frac{f_{\theta'}(X)}{f_\theta(X)} < 1 \Rightarrow \frac{f_{\theta''}(X)}{f_\theta(X)} < 1$

(b) For $X = X_{\theta'}(\theta'')$: $\quad \frac{f_{\theta''}(X)}{f_{\theta'}(X)} = 1$ and $\frac{f_{\theta'}(X)}{f_\theta(X)} < 1 \Rightarrow \frac{f_{\theta''}(X)}{f_\theta(X)} < 1$

(c) For $X \in (X_{\theta'}(\theta''), X_\theta(\theta'))$: $\quad \frac{f_{\theta''}(X)}{f_{\theta'}(X)} > 1$ and $\frac{f_{\theta'}(X)}{f_\theta(X)} < 1 \Rightarrow \frac{f_{\theta''}(X)}{f_\theta(X)} \gtrless 1$

(d) For $X = X_\theta(\theta')$: $\quad \frac{f_{\theta''}(X)}{f_{\theta'}(X)} > 1$ and $\frac{f_{\theta'}(X)}{f_\theta(X)} = 1 \Rightarrow \frac{f_{\theta''}(X)}{f_\theta(X)} > 1$

(e) For $X \in (X_\theta(\theta'), \infty)$: $\quad \frac{f_{\theta''}(X)}{f_{\theta'}(X)} > 1$ and $\frac{f_{\theta'}(X)}{f_\theta(X)} > 1 \Rightarrow \frac{f_{\theta''}(X)}{f_\theta(X)} > 1$

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Observe that (i) $f_{\theta''}(X) = f_{\theta'}(X)$ for $X = X_{\theta'}(\theta'')$ and (ii) $f_{\theta'}(X) = f_\theta(X)$ for $X = X_\theta(\theta')$. SMLRP implies that $f_{\theta''}(X)/f_\theta(X) \leq 1$ in case (c), and hence that (iii) $f_{\theta''}(X) = f_\theta(X)$ for $X = X_\theta(\theta')$. Points (ii) and (iii) together imply that (iv) $f_{\theta''}(X) = f_{\theta'}(X)$ for $X = X_\theta(\theta')$. Given that $f_{\theta''}(X) > f_{\theta'}(X)$ in case (c), points (iv) and (i) can only be reconciled with SMLRP if $X_{\theta'}(\theta'') = X_\theta(\theta')$. However, this contradicts inequality ($\bigstar$). ∎

Main proof. The proof proceeds in two steps. In the first step, we compare adjacent types and analyze local incentive-compatibility. In the second step, we show that an offer which is locally mimicking-proof is also globally mimicking-proof.

Local incentive-compatibility. Consider a type θ who, for each target share, offers a cash price P_θ, a debt claim with face value D, and a (cash-settled) knock-in call option with exercise price S_θ and trigger level T_θ.

Absent private benefits, a fully efficient equilibrium requires that the bidder's cash price is weakly lower than the expected value of the cash flow rights that she acquires. At the same time, the free-rider condition requires that the cash price is weakly higher than the expected value of the transferred cash flow rights. Both constraints can only be satisfied simultaneously if they are both binding:

$$P_\theta = \int_D^{T_\theta} (X - D)\, f_\theta(X) dX + \int_{T_\theta}^\infty (S_\theta - D)^+ \, f_\theta(X) dX.$$

Consequently, every truthful offer must yield zero bidder profits.

(i) The next higher type $\theta + 1$ does not mimic θ iff

$$-P_\theta + \int_D^{T_\theta} (X - D)\, f_{\theta+1}(X) dX + \int_{T_\theta}^\infty (S_\theta - D)^+ \, f_{\theta+1}(X) dX \leq 0.$$

Substituting for P_θ, the inequality can be written as

$$(S_\theta - D)^+ \int_{T_\theta}^\infty [f_{\theta+1}(X) - f_\theta(X)]\, dX \leq \int_D^{T_\theta} [f_\theta(X) - f_{\theta+1}(X)]\,(X - D)\, dX. \qquad (21)$$

Set $T_\theta = X_\theta(\theta + 1)$. By Lemma 3, both integrals are then *strictly* positive for any $D < T_\theta = X_\theta(\theta + 1)$, in which case there exists a $S_\theta > 0$ such that (21) is satisfied.

(ii) Analogously, the next lower type $\theta - 1$ does not mimic θ iff

$$(S_\theta - D)^+ \int_{T_\theta}^\infty [f_{\theta-1}(X) - f_\theta(X)]\, dX \leq \int_D^{T_\theta} [f_\theta(X) - f_{\theta-1}(X)]\,(X - D)\, dX. \qquad (22)$$

Set $D = X_{\theta-1}(\theta)$. By Lemma 3, the right-hand side is then *strictly* positive. By Lemma 4, $T_\theta = X_\theta(\theta + 1) \geq X_{\theta-1}(\theta)$ so that the left-hand side integral is *strictly* negative. So, (22)

holds.

Global incentive-compatibility. We now consider in turn types higher than $\theta + 1$ and types lower than $\theta - 1$.

(i) Given $T_\theta = X_\theta(\theta + 1)$ and $D = X_{\theta-1}(\theta)$, consider now the incentive-compatibility constraint of an arbitrary type $\theta^+ > \theta + 1$ vis-à-vis type θ:

$$[S_\theta - X_{\theta-1}(\theta)]^+ \int_{X_\theta(\theta+1)}^\infty [f_{\theta^+}(X) - f_\theta(X)] \, dX \leq$$
$$\int_{X_{\theta-1}(\theta)}^{X_\theta(\theta+1)} [f_\theta(X) - f_{\theta^+}(X)] [X - X_{\theta-1}(\theta)] \, dX.$$

Defining $\eta(X) \equiv f_{\theta+1}(X) - f_{\theta^+}(X)$, write the inequality as

$$[S_\theta - X_{\theta-1}(\theta)]^+ \int_{X_\theta(\theta+1)}^\infty [f_{\theta+1}(X) - f_\theta(X) - \eta(X)] \, dX \leq$$
$$\int_{X_{\theta-1}(\theta)}^{X_\theta(\theta+1)} [f_\theta(X) - f_{\theta+1}(X) + \eta(X)] [X - X_{\theta-1}(\theta)] \, dX. \quad (23)$$

By Lemma 4, $X_{\theta+1}(\theta^+) \geq X_\theta(\theta + 1)$ so that $\eta(X) > 0$ for all $X < X_\theta(\theta + 1)$. This implies that the right-hand side of (23) is larger than the right-hand side of (21), and hence *strictly* positive. Turning to the left-hand side, because

$$-\int_{X_\theta(\theta+1)}^\infty \eta(X) dX = \int_0^{X_\theta(\theta+1)} \eta(X) dX - \int_0^\infty \eta(X) dX = \int_0^{X_\theta(\theta+1)} \eta(X) dX > 0,$$

the integral on the left-hand side of (23) is larger than the integral on the left-hand side of (21), and hence *strictly* positive. We conclude that—for $T_\theta = X_\theta(\theta + 1)$ and $D = X_{\theta-1}(\theta)$—there exists a *strictly* positive price, $S_\theta > 0$, such that no type $\theta^+ > \theta$ mimics type θ.

(ii) Given $T_\theta = X_\theta(\theta + 1)$ and $D = X_{\theta-1}(\theta)$, consider now the incentive-compatibility constraint of an arbitrary type $\theta^- < \theta - 1$ vis-à-vis type θ:

$$[S_\theta - X_{\theta-1}(\theta)]^+ \int_{X_\theta(\theta+1)}^\infty [f_{\theta^-}(X) - f_\theta(X)] \, dX \leq$$
$$\int_{X_{\theta-1}(\theta)}^{X_\theta(\theta+1)} [f_\theta(X) - f_{\theta^-}(X)] [X - X_{\theta-1}(\theta)] \, dX.$$

Defining $\zeta(X) \equiv f_{\theta-1}(X) - f_{\theta^-}(X)$, write the inequality as

$$[S_\theta - X_{\theta-1}(\theta)]^+ \int_{X_\theta(\theta+1)}^\infty [f_{\theta-1}(X) - f_\theta(X) - \zeta(X)] \, dX \leq$$

$$\int_{X_{\theta-1}(\theta)}^{X_\theta(\theta+1)} [f_\theta(X) - f_{\theta-1}(X) + \zeta(X)] [X - X_{\theta-1}(\theta)] \, dX. \quad (24)$$

By Lemma 4, $X_{\theta-1}(\theta) \geq X_{\theta^-}(\theta - 1)$ so that $\zeta(X) > 0$ for all $X > X_{\theta-1}(\theta)$. This implies that the right-hand side of (24) is larger than the right-hand side of (22), and hence *strictly* positive. Turning to the left-hand side, again by Lemma 4, $X_\theta(\theta+1) \geq X_{\theta-1}(\theta) \geq X_{\theta^-}(\theta-1)$ so that $\zeta(X) > 0$ for all $X > X_\theta(\theta + 1)$. This implies that the left-hand side integral of (24) is smaller than the left-hand side integral of (22), and hence *strictly* negative. So, (24) holds. We conclude that—for $T_\theta = X_\theta(\theta + 1)$, $D = X_{\theta-1}(\theta)$, and $S_\theta > 0$—no type $\theta^- < \theta$ mimics type θ. ■

References

At, Christian, Mike Burkart and Samuel Lee, 2007, "Security-Voting Structure and Bidder Screening," FMG Discussion Paper No 575.

Bebchuk, Lucian A. and Oliver Hart, 2001, "Takeover Bids vs. Proxy Fights in Contests for Corporate Control," CEPR Discussion Paper, No. 3073, ECGI - Finance Working Paper No. 4.

Berkovitch, Elazar and M. P. Narayanan, 1990, "Competition and the Medium of Exchange," Review of Financial Studies, 3(2), 153-174.

Betton, Sandra, B. Espen Eckbo, and Karin S. Thorburn, 2008, "Corporate Takeovers," in B.E. Eckbo (ed.) Handbook of Corporate Finance: Empirical Corporate Finance, Vol. 2, Elsevier/North-Holland, Ch. 15, 289-427.

Bhattacharya, Sugato, 1990, "The Analytics of Takeover Bidding: Initial Bids and their Premia," mimeo.

Bradley, Michael, 1980, "Interfirm Tender Offers and the Market for Corporate Control," Journal of Business, 53, 345-376.

Brav, Alon and Richmond D. Matthews, 2009, "Empty Voting and the Efficiency of Corporate Governance," Fuqua School of Business.

Brusco, Sandro, Guiseppe Lopomo, David T. Robinson and S. Viswanhatan, 2007, "Efficient Mechanisms for Mergers and Acquisitions," International Economic Review, 48 (3), 995-1035.

Burkart, Mike, Denis Gromb and Fausto Panunzi, 1998, "Why Takeover Premia Protect Minority Shareholders," Journal of Political Economy, 106(1), 172-204.

Burkart, Mike, Denis Gromb and Fausto Panunzi, 2006, "Minority Blocks and Takeover Premia," Journal of Institutional and Theoretical Economics, 162(1), 32-49.

Burkart, Mike and Samuel Lee, 2009, "Smart Buyers," Stockholm School of Economics and New York University.

Chakraborty, Archishman and Bilge Yilmaz, 2009, "Adverse Selection and Convertible Bonds," Review of Economic Studies, forthcoming.

Chowdhry, Bhagwan and Narasimhan Jegadeesh, 1994, "Pre-Tender Offer Share Acquisition Strategy in Takeovers," Journal of Financial and Quantitative Analysis, 29(1), 117-129.

Chowdhry, Bhagwan and Vikram Nanda, 1993, "The Strategic Role of Debt in Takeover Contests," Journal of Finance, 48(2), 731-745.

Christofferson, Susan E.K., Christopher C. Geczy, David K. Musto, and Adam V. Reed, 2007, "Vote Trading and. Information Aggregation," Journal of Finance 62, 2897-2929.

DeMarzo, Peter and Darrell Duffie, 1999, "A Liquidity-Based Model of Security Design," Econometrica, 67(1), 65-99.

Eckbo, B. Espen, Ronald M. Giammarino and Robert L. Heinkel, 1990, "Asymmetric Information and the Medium of Exchange in Takeover: Theory and Tests," Review of Financial Studies, 3(4), 651-675.

Ferreira, Daniel, Emanuel Ornelas and John L. Turner, 2007, "Unbundling Ownership and Control," ECGI Working Paper 172/2007.

Finnerty, John D. and An Yan, 2009, "Convertible Securities in Merger Transactions," Fordham University.

Fishman, Michael J., 1988, "A Theory of Pre-emptive Takeover Bidding," Rand Journal of Economics, 19(1), 88–101.

Fishman, Michael J., 1989, "Preemptive Bidding and the Role of the Medium of Exchange in Acquisitions," Journal of Finance, 44(1), 41-57.

Grossman, Sanford J. and Oliver D. Hart, 1980, "Takeover Bids, the Free-rider Problem, and the Theory of the Corporation," Bell Journal of Economics, 11(1), 42-64.

Grossman, Sanford J. and Oliver D. Hart, 1981, "The Allocational Role of Takeover Bids in Situations of Asymmetric Information", Journal of Finance 36(2), 253-270.

Grossman, Sanford J. and Motty Perry, 1986, "Perfect Sequential Equilibria," Journal of Economic Theory, 39, 97-119.

Hansen, Robert G., 1987, "A Theory for the Choice of Exchange Medium in Mergers and Acquisitions," Journal of Business, 60(1), 75-95.

Hirshleifer, David and Sheridan Titman, 1990, "Share Tendering Strategies and the Success of Hostile Takeover Bids," Journal of Political Economy, 98(2), 295-324.

Holmström, Bengt and Barry Nalebuff, 1992, "To the Raider Goes the Surplus? A Reexamination of the Free Rider Problem," Journal of Economics and Management Strategy, 1(1), 37-62.

Hu, Henry T.C. and Bernard Black, 2006, "The New Vote Buying: Empty Voting and Hidden (Morphable) Ownership," Southern California Law Review, 79(4), 811-908.

Hu, Henry T.C. and Bernard Black, 2008, "Equity and Debt Decoupling and Empty Voting II: Importance and Extensions," University of Pennsylvania Law Review, 156, 625-739.

Innes, Robert, 1990, "Limited Liability and Incentive Contracting With Ex-Ante Action Choices," Journal of Economic Theory, 52, 45-68.

Jensen, Michael C., 1986, "Agency costs of free cash flow, corporate finance and takeovers," American Economic Review, 76 (2), 323–329.

Jensen, Michael C. and Meckling, William H., 1976, "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure," Journal of Financial Economics, 3, 305-360.

Judd, Kenneth L., 1985, "The law of large numbers with a continuum of IID random variables," Journal of Eonomic Theory, 35(1), 19-25.

Kalay, Avner and Shagun Pant, 2009, "Time Varying Control Rights and the Private Benefits of Control," Working Paper.

Laffont, Jean-Jacques and David Martimort, 2002, The Theory of Incentives, Princeton University Press, Princeton N.J.

Leland, Hayne E. and David H. Pyle, 1977, "Informational Asymmetries, Financial Structure, and Financial Intermediation," Journal of Finance, 32 (2), 371-387.

Liu, Tingjun, 2008, "Takeover Bidding with Signaling Incentives," Carey School of Business, Arizona State University.

Marquez, Robert and Bilge Yilmaz, 2005, "Takeover Bidding and Shareholder Information," University of Pennsylvania.

Marquez, Robert and Bilge Yilmaz, 2008, "Information and Efficiency in Tender Offers," Econometrica, 76(5), 1075-1101.

Martin, Kenneth J., 1996, "The Method of Payment in Corporate Acquisitions, Investment Opportunities, and Management Ownership," Journal of Finance, 51(4), 1227-1246.

Martynova, Marina and Luc Renneboog, 2009, "What determines the financing decision in corporate takeovers: Cost of capital, agency problems, or the means of payment?," Journal of Corporate Finance, 15, 290–315.

Maskin, Eric and Jean Tirole, 1990, "The Principal-Agent Relationship with an Informed Principal: The Case of Private Values," Econometrica, 58(2), 379-409.

Gaugham, Patrick, 2002, Mergers, Acquisitions and Corporate Restructuring, 3rd edition John Wiley & Sons.

Müller, Holger and Fausto Panunzi, 2004, "Tender Offers and Leverage," Quarterly Journal of Economics, 119(4), 1217-1248.

Myers, Stewart and Nicholas S. Majluf, 1984, "Corporate Financing and Investment Decisions when Firms have Information that Investors do not have," Journal of Financial Economics, 13, 187-221.

Nachman, David C. and Thomas H. Noe, 1994, "Optimal Design of Securities Under Asymmetric Information," Review of Financial Studies, 7(1), 1-44.

Officer, Micah, 2004, "Collars in Merger Negotations," Journal of Finance, 59, 2719–2743.

Osano, Hiroshi, 2009, "Acquisition Mode and Financing in Takeovers," Kyoto University.

Schlingemann, Frederik P., 2004, "Financing decisions and bidder gains," Journal of Corporate Finance, 10, 683– 701.

Shleifer, Andrei and Robert W. Vishny, 1986, "Large Shareholders and Corporate Control," Journal of Political Economy, 94(3, Part 1), 461-488.