Competition and the Medium of Exchange in Takeovers

Elazar Berkovitch
M. P. Narayanan
The University of Michigan

The role of the medium of exchange in competition among bidders and its effect on returns to stockholders in corporate takeovers are investigated. Consistent with recent empirical evidence, our model shows that stockholders of both acquiring and target firms obtain higher returns when a takeover is financed with cash rather than equity, and that returns to target shareholders increase with competition. The model predicts that the fraction of synergy captured by the target decreases with the level of synergy. Finally, it is shown that, as competition increases, the cash component of the offer as well as the proportion of cash offered increases.

Several studies examine the effects of competition and the medium of exchange on the returns to target and acquiring firms' stockholders. Usually the effects of these two factors are studied independently. Bradley, Desai, and Kim (1988) document that when there are competing bidders in tender offers, the average gain to the winner is lower, and the average gain to the target is higher, than in the absence of compe-

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tition. Investigations of the effect of the medium of exchange have found that stockholders of *both* acquiring and target firms earn higher returns when the acquisition is financed by cash rather than stock [see Asquith, Bruner, and Mullins (1987), Eckbo, Giammarino, and Heinkel (1989), Franks, Harris, and Meyer (1988), Travlos (1987), Huang and Walkling (1987), and Wansley, Lane, and Yang (1983)].

In this article, we investigate the role of the medium of exchange in competition among bidders, and its effect on the returns to the stockholders of both the acquirer and the target. We provide a theory that is consistent with the empirical findings cited above regarding competition and the medium of exchange. In addition, our model explains how the synergy is shared between the acquirer and the target and yields additional testable hypotheses relating the effect of competition (both potential and actual) in the market for corporate control to the medium of exchange used in acquisitions.

Most of the insights of this analysis are established in a model with two types of acquirer, High and Low. The value of the combined firm under the High type is greater than that under the Low type. Initially, a potential acquirer arrives and makes an offer with a specific medium of exchange, which the target can either accept or reject. If the offer is rejected, there is a costly delay before another offer can be made by this bidder. At that time, another potential acquirer may enter the fray. If this occurs, there is competition between the two bidders, and the highest bid may be accepted or rejected by the target. If rejected, the process repeats after a further delay.

In this setting, under symmetric information the target receives a higher dollar amount if it is acquired by the High type, but receives a higher fraction of the synergy if it is acquired by the Low type. This is because the Low type faces greater competition than the High type and is willing to offer the target a higher proportion of the synergy. Moreover, the offers are accepted without delay in equilibrium.

If only the acquirer knows its type, then there is a unique (in payoffs) separating sequential equilibrium in which the High-type acquirer uses a higher amount of cash and the Low type uses a higher proportion of equity and the values of the offers are the same as in the symmetric-information case. Since the fraction of the synergy offered by the Low type is higher than that offered by the High type, the latter clearly has no incentive to mimic the former by offering equity. Similarly, since the dollar value of the offer made by the Low type is lower than that made by the High type, the former does not have an incentive to mimic the latter by offering cash. As in the symmetric-information case, the offers are accepted without delay.

The model has the following empirical implications: First, takeovers financed with cash are associated with higher returns to the stockholders of both the acquirer and the target than takeovers financed with equity; second, the fraction of synergy captured by the target decreases with the level of total synergy, while the dollar amount captured increases with the level of total synergy; third, an increase in competition among the bidders raises the fraction of the synergy captured by the target and the amount of cash used to finance the takeover; finally, the cash fraction of the offer also increases with competition.

While, to our knowledge, no paper has explored the role of the medium of exchange in competition between bidders, several theories have been advanced to explain the effects of the medium of exchange [see Hansen (1987), Fishman (1989), and Eckbo, Giammarino, and Heinkel (1989)].[1] In these models bidders whose private information is more favorable (regarding either their own premerger values or the synergy) use cash as the medium of exchange, and this explains why the stock prices of *bidders* react more favorably to cash offers than to stock or other security offers. However, unlike our model, these models do not explain why the targets' stock prices also react in the same fashion. In Eckbo, Giammarino, and Heinkel (1989), the target's share price rises at the announcement of the acquisition by an amount that is independent of the medium of exchange. This is because the bidder is constrained to make an offer that is acceptable to all types of targets so that there is no separation of the target types in equilibrium. In Fishman (1989), the reaction of the target's stock price to the announcement of the acquisition is ambiguous: Only if the minimum preemptive cash offer is greater than the expected value to the target from competition (given that there is no preemption) will the target's stock price react positively to a cash offer. A similar ambiguity arises in Hansen (1987).

The article is organized as follows. In Section 1, a model with two types of bidders is described. In Section 2, equilibrium offers under symmetric information are analyzed. In Section 3, asymmetric information is introduced and a nondissipative signaling equilibrium is obtained in which the High type offers more cash and less equity than the Low type. In Section 4, the effect of potential competition on the medium of exchange is analyzed, and in Section 5, the effect of actual competition on the medium of exchange is considered. In Section 6, the model is extended to more than two types of bidders and the conditions under which the results obtained for the two-type case continue to hold are derived. In Section 7, we present our conclusions.

[1] In Fishman (1989), the medium of exchange affects competition. Cash is more effective in deterring competition. However, the article does not analyze the effect of competition on the sharing of the synergy.

1. A Model with Two Types

Consider a firm (the target) that may be a source of synergy if combined with other firms. The source of the synergy may be economies of scale, inefficient incumbent management, combining complementary resources, etc. We concentrate on the division of this synergy and its relation to the medium of exchange. For convenience, we consider only mergers and full tender offers in which the target ceases to exist as a separate entity.

The target is identified as a source of synergy by a potential acquirer. The acquirer could be one of two types. If the acquirer is type $l(h)$, the synergy is $L(H)$, where $H > L$. While only the acquirer knows its type, it is common knowledge that the acquirer is type l with probability q or type h with probability $(1 - q)$. The premerger values of both the acquirer and the target are common knowledge, and, for simplicity, are assumed to be zero. The acquirer makes a bid that the target can either accept or reject.[2] The bid consists of an amount of cash and a fraction of equity in the combined firm. If the target rejects the initial bid, a second bid can be made by the acquirer only after a delay.[3] The important feature of the delay is that it is costly to both the acquirer and the target.[4] One reason for the cost is that the benefits of the merger are postponed. The discount factor δ ($\delta < 1$) represents the cost of delay.

If the target rejects the initial bid, other potential acquirers may enter. The probability that a new bidder will enter in any given period is denoted by r. There is no cost of entry. All new bidders have the same distribution of synergy [H with probability $(1 - q)$], which is common knowledge, although the value of the synergy is private information. Upon entry of a new bidder, both bidders compete in an English (progressive) auction without delay. At the end of the auction, the higher-value bidder will bid the value of the lower bidder, or a higher value, if necessary, to prevent the target from rejecting the bid and waiting for a higher bid.[5]

All agents are assumed to be risk neutral. There are no agency problems between the management and the shareholders and the

[2] The qualitative results of the article will not change even if the target is permitted to make counteroffers. In this case, the target's payoff will be the maximum of the Rubinstein solution and its value from competition [see Sutton (1986)]. Since our analysis is based on the value from competition, our results hold as long as this value is not too low.

[3] Since the Williams Act requires that a tender offer be kept open for at least 20 working days, the bidder learns of a rejection only after a delay. Therefore, a rebid after rejection involves a delay. However, a bidder may revise its bid any time without waiting for the target's response. In our model, this happens only if there is competition.

[4] If delay is costless, the target will be prepared to wait until it receives a bid of H [see Rubinstein (1982) for the role of delay in bargaining].

[5] We will derive the higher bid if it exists and the condition under which it exists.

management seeks to maximize shareholders' wealth. We ignore taxes in order to concentrate on the signaling aspects of the medium of exchange.

2. Bidding under Symmetric Information

The medium of exchange is clearly irrelevant under symmetric information. However, an understanding of the bidding process under symmetric information is helpful since the equilibrium payoffs under asymmetric information are the same as under symmetric information.

Suppose that the target is facing a bidder of known type h. The target will accept any offer that equals or exceeds its expected payoff from rejection. Therefore, the equilibrium offer is equal to the present value of the target's expected payoff from rejection. This value is given by

$$V(h) = \delta rq \max\{L, V(h)\} + \delta r(1 - q)H + \delta(1 - r)V(h) \quad (1)$$

The last term represents the payoff to the target if there is no competition in the next period. This assumes that the payoff to the target from rejection in the next period, if there is no competition, is the same as the payoff from rejection in this period. Since the arrival process is stationary, the unique stationary subgame-perfect equilibrium strategy is for the type h bidder to bid $V(h)$ in each period if there is no competition [see Berkovitch and Khanna (1989)]. The second term represents the payoff if the competition is from type h. In this case the target will receive H, the outcome of the English auction. The first term represents the payoff if the competition is from type l. If $L > V(h)$, the target will accept L, the outcome of the English auction. On the other hand, if $L \leq V(h)$, the type h bidder has to bid $V(h)$ since the target will reject any lower bid. Solving Equation (1) for $V(h)$,

$$V(h) = \begin{cases} \delta r[qL + (1 - q)H]/[1 - \delta(1 - r)] & \text{if } L > V(h) \quad (2) \\ \delta r(1 - q)H/[1 - \delta rq - \delta(1 - r)] & \text{otherwise} \quad (3) \end{cases}$$

Similarly, type l acquirer's equilibrium bid is given by

$$V(l) = \delta rqL + \delta r(1 - q) \max\{L, V(h)\} + \delta(1 - r)V(l) \quad (4)$$

The last term represents the payoff to the target if there is no competition, in which case, under stationary conditions, the target will receive $V(l)$. The second term represents the payoff if the competition is from type h. If $L > V(h)$, the outcome of the auction, L, will be accepted by the target. If $L \leq V(h)$, the type h bidder will bid $V(h)$ since any lower bid will be rejected by the target. The first term represents the payoff if the competition is from type l and if $V(l) < L$. Note that the assumption that $V(l) < L$ is necessary to ensure that type l will enter the bidding. Solving Equation (4) for $V(l)$, we get

$$V(l) = \begin{cases} \delta r L/[1 - \delta(1 - r)] & \text{if } L > V(h) \quad (5) \\ [\delta rqL + \delta r(1 - q) V(h)]/[1 - \delta(1 - r)] & \text{otherwise} \quad (6) \end{cases}$$

The proportion of the synergy obtained by the target as a function of the acquirer's type is given by

$$\alpha(h) \equiv V(h)/H \qquad \text{and} \qquad \alpha(l) \equiv V(l)/L \tag{7}$$

The following proposition describes the relative payments of the two types of acquirers.

Proposition 1. *$\alpha(h) < \alpha(l)$, but $V(h) = \alpha(h)H > V(l) = \alpha(l)L$. Type h pays a lower fraction of the synergy than type l, but pays a higher dollar amount.*

Proof. See the Appendix. ■

The result may be understood as follows. Suppose that $L \geq V(h)$. Then, the incremental synergy if the first bidder is type h rather than type l is $H - L$. However, the expected incremental payoff to the target is less than $H - L$ because it obtains this amount only if the second bidder is type h, and this occurs with probability less than 1. Hence, the target is able to capture only a fraction of the incremental synergy of the first bidder so that, although the dollar amount it obtains increases with the synergy of the bidder, the fraction of the synergy it receives decreases.

Let $\{C, \alpha\}$ denote an offer, where C is the amount of cash and α is the fraction of the equity. In equilibrium the offers must satisfy

$$C + \alpha(H - C) = V(h) \text{ and } C + \alpha(L - C) = V(l) \tag{8}$$

The loci of equilibrium offers $\{C, \alpha\}$ of types h and l are represented by the curves AB and CD, in Figure 1. Condition (8) implies that these curves are monotonically decreasing and strictly concave and that they intersect once at $\{C^*, \alpha^*\}$, where

$$\alpha^* = [V(h) - V(l)]/(H - L) \tag{9}$$

and

$$\begin{aligned} C^* &= [V(h) - \alpha^* H]/(1 - \alpha^*) \\ &= [V(l)H - V(h)L]/\{(H - L) - [V(h) - V(l)]\} \end{aligned} \tag{10}$$

Under symmetric information, all cash and equity offers by type l (h) along the loci AB (CD) are equivalent. In order to explain the

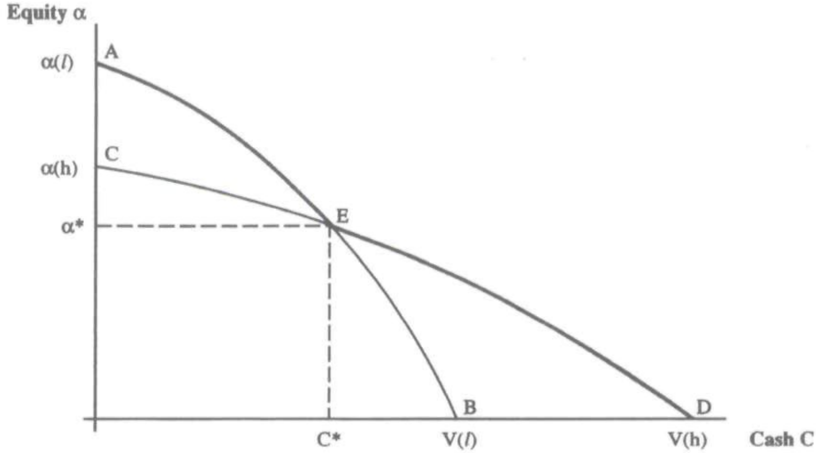

Figure 1
Separating equilibria with cash and equity
AB (*CD*) represents the loci of offers $\{C, \alpha\}$ that have the value $V(l)$ $[V(h)]$ if offered by type l (h). In equilibrium, type l makes offers along *AE* and type h makes offers along *ED*.

composition of the offers in equilibrium, we now introduce an informational asymmetry between the bidder and the target.

3. Separating Equilibrium with Cash and Equity

In this section, it is assumed that only the bidder knows the value of the synergy. The bid $\{C, \alpha\}$ specifies C, the amount of cash, and α, the fraction of equity in the combined firm, offered to the target. It is assumed that the cash is raised by a riskless debt issue.[6] Knowing the bid, the target updates its beliefs about the bidder's type and decides whether to accept or reject the bid. If the target rejects the bid, competition may develop as in the symmetric-information case. If there is no competition the bidder bids again and the process repeats.

A strategy for each type of bidder is a function that prescribes a bid for each possible history given that there has been no previous acceptance. The target's strategy is a function that prescribes for each infor-

[6] We assume that the cash is raised by issuing risk-free debt to be consistent with our assumption that there are no assets in place. Since we show later that the minimum amount of cash that type h has to offer to separate itself in equilibrium is less than L, the acquirer can issue risk-free debt. Or, equivalently, if the acquirer has other assets in which it does not have to give the target equity participation, it can use these assets to raise the cash. In a model where the acquirer has assets in place in which it has to give the target equity participation, it can use these assets to raise the required cash as long as there is no informational asymmetry regarding the assets.

mation set of the target whether to accept or reject the last bid. The equilibrium concept used is the sequential equilibrium of Kreps and Wilson (1982). Each player chooses his best strategy given his beliefs, taking the other players' strategies as given. The beliefs are determined by Bayes' rule whenever possible. In a separating equilibrium the strategy of the bidder reveals its type.

In describing the equilibrium, we eschew unnecessary formalism without compromising rigor. Suppose a separating equilibrium exists in which type i makes the offer $\{C_i, \alpha_i\}$.[7] Let $V_e(i)$, $i = h, l$, be the target's payoff in equilibrium if the bidder is type i. For the target to accept the offer, $V_e(i)$ must be greater than or equal to the value from rejection when the target believes the bidder to be type i. The key result proved in Proposition 2 is that, in the (unique) separating equilibrium, the value from rejection is $V(i)$, the same as the value from rejection under symmetric information. Hence the equilibrium strategy for the bidder is to bid $V(i)$, which is the lowest acceptable bid.[8] Therefore, $V_e(i) = V(i)$, $i = h, l$. The following conditions must be satisfied to ensure that neither bidder type has an incentive to mimic the other:

$$C_h + \alpha_h(L - C_h) \geq V(l) \tag{11}$$

and

$$C_l + \alpha_l(H - C_l) \geq V(h) \tag{12}$$

Equation (11) [(12)] ensures that type l (h) does not mimic type h (l).

Since the target's equilibrium payoff is $V(i)$ when the bidder is type i, curve AB in Figure 1 represents the locus of all possible acceptable offers type l can make while curve CD represents the locus of all possible acceptable offers type h can make. However, only offers on the portion AE of AB are incentive compatible, that is, satisfy condition (12). Similarly, only offers on the portion ED are incentive compatible, that is, satisfy condition (11). Therefore, all equilibrium offers must lie on the envelope AED, with type l making offers on AE and type h making offers on ED.

To see the intuition behind this argument, consider the special case where offers of cash only or equity only can be made. Clearly the target has no incentive to reject a cash offer of $V(h)$ or higher

[7] It is shown in Section 6 that for a continuum of types, pooling equilibria cannot exist if the value from rejection is a concave function of the type. For the two-type case it can be shown that the only pooling equilibrium that exists has the same payoffs as the separating equilibrium.

[8] It may look surprising to the reader familiar with the signaling literature that we obtain a unique sequential equilibrium (in payoffs) with payoffs identical to those in the symmetric-information case. The reason for this is the dynamic nature of the model, which gives additional structure that enables us to eliminate the multiple equilibria.

since it cannot do better irrespective of the type making this offer. Similarly, the target has no incentive to reject an equity offer of $\alpha(l)$ or higher. The target has no incentive to accept cash offers less than $V(l)$ and equity offers less than $\alpha(h)$, irrespective of its beliefs, since the payoffs from accepting these offers are lower than its expected payoff from waiting, irrespective of the type of the bidder making these offers. For cash offers between $V(l)$ and $V(h)$ and equity offers between $\alpha(h)$ and $\alpha(l)$, there exist several sets of target beliefs that make it optimal for it to reject these offers.

The above intuition can be extended to offers involving a mixture of cash and equity. The following proposition summarizes the above discussion and establishes a separating equilibrium.

Proposition 2. *In any separating equilibrium type h pays a total amount of $V(h)$ and type l pays a total amount of $V(l)$, without delay. Type h pays more than C^* in cash and type l pays less than C^* in cash.*

Proof. We shall show that the following set of strategies and beliefs constitutes a unique (with respect to payoffs) separating equilibrium. For the sake of simplicity, we do not state here the actions and beliefs of the players in the off-equilibrium path of actual competition that might arise if the first bidder's offer is rejected. These actions and beliefs are stated in detail in the proof of Proposition 6. In any given period, if no competition has arrived thus far,

1. Type h bidder offers $\{C, \alpha\}$ where $C > C^*$ and $C + \alpha(H - C) = V(h)$
2. Type l bidder offers $\{C, \alpha\}$ where $C < C^*$ and $C + \alpha(L - C) = V(l)$
3. Target accepts offers $\{C, \alpha\}$ where $C \geq C^*$ if and only if $C + \alpha(H - C) \geq V(h)$ and accepts offers $\{C, \alpha\}$ where $C < C^*$ if and only if $C + \alpha(L - C) \geq V(l)$
4. Target's set of beliefs: Offers $\{C, \alpha\}$ where $C \geq C^*$ imply type h and $\{C, \alpha\}$ where $C < C^*$ imply type l, regardless of previous beliefs.

In the proposed equilibrium there will be no actual competition since the bidder who arrives in the first period will make the equilibrium offer (taking into account, of course, the competition that might arise if an unacceptable offer is made) and that will be accepted.

Given this set of strategies and beliefs, type h has no incentive to make offers $\{C, \alpha\}$ where $C > C^*$ and $C + \alpha(H - C) > V(h)$, since these offers will be accepted resulting in a payoff greater than $V(h)$ to the target. Similarly, it has no incentive to make offers $\{C, \alpha\}$ where $C < C^*$ and $C + \alpha(L - C) > V(l)$, since by the definition of C^* the true value of these offers is strictly greater than $V(h)$. Also, type h has no incentive to make any offer that will be rejected by the target since upon rejection, if competition develops, its payoff next period will be less than its current period payoff from the equilibrium offer. If competition does not develop, the bidder is in the same situation next period as it is now but incurs the cost of delay. Hence, it will not make such offers. This rules out all other off-equilibrium offers. By a similar line of reasoning, it can be easily shown that the prescribed strategy for type l is optimal.

The target is better off accepting offers $\{C, \alpha\}$ where $C \geq C^*$ and $C + (H - C) \geq V(h)$, and offers $\{C, \alpha\}$ where $C < C^*$ and $C + \alpha(L - C) \geq V(l)$, given its beliefs. If type i, $i = h, l$, makes such offers, the target's payoff is greater than or equal to $V(i)$, the symmetric-information payoff. All other offers should be rejected. If, for example, type h makes the offer $\{C, \alpha\}$ where $C \geq C^*$ and $C + \alpha(H - C) < V(h)$, the target's payoff from rejecting the offer is $V(h)$ given its belief that such offers come from type h [see Equation (1)]. Hence it is optimal for the target to reject the bid. Similar arguments show that it is optimal for the target to reject offers $\{C, \alpha\}$ where $C < C^*$ and $C + \alpha(L - C) < V(l)$.

In order to show uniqueness, first note that any sequential equilibrium must be such that the target accepts any bid greater than or equal to its expected payoff from rejecting the bid, and the bidder bids the target's expected payoff from rejection. As shown in the symmetric-information case, the unique bid that satisfies these properties is $V(i)$ for type i, $i = h, l$. Since in the separating equilibrium the types are revealed before the target has to respond, these are the unique payoffs in such an equilibrium. ∎

4. Effect of Potential Competition on Payoffs and the Medium of Exchange

In order to investigate the effect of the intensity of potential competition on the sharing of synergy and the medium of exchange, we consider variation in r, the probability that a competing bidder will emerge in any period. It is easily verified from Equations (1) and (4) that $V(h)$ and $V(l)$ are increasing functions of r. This conforms to our intuition that the target's payoff should increase with increasing competition among bidders.

Proposition 3. $\partial V(i)/\partial r > 0$, $i = h, l$. *The target's share of the synergy increases as the intensity of potential competition increases.*

Consider next the effect of the intensity of potential competition on the medium of exchange. Specifically, we investigate the effect of

r on C^*. Since C^* is the minimum cash that a type h bidder has to offer to separate itself, it can be considered as a measure of the amount of cash in the offer. The relevance of this measure becomes more obvious when we extend the model to a continuum of types. As the following proposition shows, C^* is a strictly increasing function of r.

Proposition 4. *$\partial C^*/\partial r > 0$. The minimum amount of cash the type h bidder has to offer in order to separate itself increases with the intensity of competition.*

Proof. See the Appendix. ■

The intuition behind this result is as follows. The effect of r on C^* is through $V(h)$ and $V(l)$. As r increases, both $V(h)$ and $V(l)$ increase (Proposition 3). However, their effect on C^* is in opposite directions. C^* increases with $V(l)$ and decreases with $V(h)$. The reason C^* increases with $V(l)$ is that, in equilibrium, type l will pay exactly $V(l)$ in total if it pays C^* in cash. As long as C^* remains constant, this amount is unchanged [see Equation (8)]. Therefore, if $V(l)$ increases and C^* remains constant, type l can mimic type h by paying the same amount as before. Since this is profitable for type l, C^* has to increase. For similar reasons C^* decreases with $V(h)$. As the proposition shows, it turns out that the effect of $V(l)$ on C^* dominates that of $V(h)$.

Proposition 4 suggests that the amount of cash used in acquisitions increases with potential competition. Since type h differentiates itself by offering more cash, it is also interesting to investigate whether the cash component as a fraction of the amount paid by type h, $C^*/V(h)$, is increasing in r. It turns out that this result does not hold in general in our model. What we find is that $C^*/V(h)$ is an increasing function of r if $L > V(h)$, as stated in the following proposition. The proof is straightforward.

Proposition 5. *$\partial[C^*/V(h)]/\partial r > 0$ whenever $L > V(h)$.*

5. Actual Competition

In proving Proposition 2 we assumed the outcome of actual competition, namely, that the bidder's payoff under actual competition is less than its equilibrium payoff under potential competition. In this section we prove that this outcome is the unique equilibrium outcome and investigate the effect of actual competition on the medium of exchange. To incorporate actual competition, we add to the model in Section 1 the possibility that a competitor may enter in the first period, immediately after the first bid is made. In order to be consistent with the model in Section 1, we assume that the competitor enters with probability r. In this case the game evolves as follows.

The first bidder makes a bid with a mixture of cash and equity. If no competitor enters in that period the target either accepts or rejects the first bid. If the target rejects the bid the game evolves in the same fashion as before. If a competitor enters in the first period, the game evolves as an auction in which the competitors bid alternately without delay. When no bidder revises its bid, the outstanding offers become the final offer set from which the target may choose one. The target may reject both offers in which case the competing bidders may bid again after a delay. We use a final offer set instead of a final bid because a bid has two dimensions, namely, cash and equity. In many cases it is not possible to tell which of the two offers is superior without specifying the belief system of the target. For example, consider the final bids $\{V(h), 0\}$ and $\{0, 1\}$ where $V(h) > L$. If the target believes that the second bid is made by type h it should accept this bid and reject the first one. On the other hand, if it believes that the second bid is made by type l, it should accept the first bid. The following proposition describes the unique equilibrium payoffs.

Proposition 6.

I. *If no competition develops, the equilibrium outcome (payoffs and mediums of exchange) is identical to that in Proposition 2.*

II.

1. *If competition develops between two type l bidders, the final accepted bid is $\{0, 1\}$.*
2. *If competition develops between two type h bidders, the final accepted bid is $\{H, 0\}$.*
3. *If competition develops between type h and type l, the final accepted bid is $\{L, 0\}$ if $V(h) < L$; otherwise, it is $\{C, \alpha\}$ where $C \geq L$ and $C + \alpha(H - C) = V(h)$.*[9]

Proof. See the Appendix. ■

If actual competition is between two bidders of the same type, the winning bidder gets nothing; if it is between type h and type l, type h gets $H - L$. Note that under actual competition the optimal medium of exchange is quite often the corner solution: either all cash or all equity. Equilibrium offers of cash and equity are possible only if type h competes against type l and $V(h) > L$.[10] In contrast, when there is

[9] A cash offer of L by type h should be interpreted as $L + \epsilon$, where ϵ is a small positive number. This is required for type h to outbid type l.

[10] We show in Section 6 that in the case of a continuum of types all except the lowest type will make all-cash offers. This implies that we will see predominantly all-cash offers under actual competition as long as the distribution of types does not have a mass point at the lowest type.

only potential competition, equilibrium offers can involve mixtures of cash and equity in all situations.[11]

6. Generalization to a Continuum of Types

In this section we extend the results of the previous sections to a continuum of bidder types. In Section 6.1 we derive the conditions under which a separating equilibrium with symmetric-information payoffs exists, as in the two-type case. We also present a simple geometric interpretation of this equilibrium.[12] In Section 6.2 we show that no pooling equilibrium exists.

6.1 Separating equilibria with symmetric-information payoffs

We first consider the case of potential competition. Let $F(\cdot)$ represent the probability distribution of the bidder types. The support of $F(\cdot)$ is the interval $[a, b]$, where $a > 0$. A type x bidder possesses synergy value x. $V(x)$ denotes the target's expected payoff when it faces a bidder of type x under symmetric information. The remainder of the notation is the same as in Section 1.

We assume that $V(x) < x$ for all x. If this is not true, type x has no incentive to enter the market. $V(x)$ is given by

$$V(x) = \delta r\left[\int_a^x \max\{V(x), s\}\, dF(s) + \int_x^b \max\{x, V(s)\}\, dF(s)\right] + \delta(1 - r)V(x) \tag{13}$$

If s, the synergy of the bidder arriving next period (if one arrives), is less than that of type x, the target will get the maximum of $V(x)$ and s. If this synergy is greater than x, the target will get the maximum of $V(s)$ and x. If no bidder arrives the target will receive a bid of $V(x)$ next period from bidder x. As in the two-type case, define

$$\alpha(x) \equiv V(x)/x$$

[11] It can be shown that pooling equilibria do not exist under actual competition. If $V(b) < L$, actual competition always reveals the types of the bidders. This is because when types b and l compete, type b can easily reveal itself by offering L in cash. If $V(b) \geq L$, however, it is possible that a pooling outcome exists where types b and l cannot be separated. In this case, type b may be better off bidding $\{L, 0\}$ and not revealing itself than bidding $\{C, \alpha\}$ where $C > L$ and $C + \alpha(H - C) = V(b)$. It will be optimal for type b to do so if the target believes with high enough probability that a bid of $\{L, 0\}$ is made by type l and, therefore, accepts such bids with high enough probability. This equilibrium can be ruled out as follows. It is a dominant strategy for the target to accept $\{C, \alpha_1\}$ over $\{C, \alpha_2\}$ if $\alpha_1 > \alpha_2$. If the target adopts this rule, then type l will try to offer as high an α as needed to win with probability 1 while keeping $C = L$. This costs type l nothing but is costly for type b to mimic. Hence, it will prefer to separate itself by offering $\{C, \alpha\}$ with $C > L$ and $C + \alpha(H - C) = V(H)$. This breaks the pooling equilibrium.

[12] We are grateful to one of the referees for suggesting this line of reasoning.

We now state the extension of Proposition 1 to a continuum of types. The proposition can be proved in a straightforward fashion.

***Proposition* 7.** *Under symmetric information, $\alpha(x)$ is strictly decreasing in x and $V(x)$ is strictly increasing in x.*

Let us first consider the intuition behind the separating equilibrium with symmetric-information payoffs. An offer $\{C, \alpha\}$ made by type x is worth

$$g(x;\ C, \alpha) \equiv C + \alpha(x - C) = (1 - \alpha)\ C + \alpha x \qquad (14)$$

Note that $g(\cdot)$ is affine in x. In a separating equilibrium with symmetric-information payoffs, the target will not accept any offer of value less than $V(\hat{x})$ from type $\hat{x}$. At the same time, the type $\hat{x}$ bidder will make a bid such that it is unprofitable for other types to mimic it. Therefore, the type $\hat{x}$ bidder's problem is

$$\underset{\{C, \alpha\}}{\mathrm{Min}}\ g(\hat{x};\ C, \alpha)$$

such that

$$g(x;\ C, \alpha) > V(x) \qquad \text{for all } x \neq \hat{x} \qquad (15)$$

and

$$g(\hat{x};\ C, \alpha) \geq V(\hat{x}) \qquad (16)$$

Figure 2 demonstrates that a unique solution to this problem exists if and only if V is strictly concave. It can be seen from the figure that the minimum $g(x;\ C, \alpha)$ that satisfies conditions (15) and (16) is a straight line that is tangent to $V(x)$ at $\hat{x}$. When V is concave and differentiable, this tangent is the unique supporting hyperplane and is given by

$$\begin{aligned} g(x;\ C, \alpha) &= V(\hat{x}) + V'(\hat{x})(x - \hat{x}) \\ &= \frac{[1 - V'(\hat{x})][V(\hat{x}) - \hat{x}V'(\hat{x})]}{1 - V'(\hat{x})} + V'(\hat{x})x \end{aligned} \qquad (17)$$

where $V'(x) \equiv \partial V/\partial x$. Comparing Equations (14) and (17), $\{C^*(\hat{x}), \alpha^*(\hat{x})\}$, the equilibrium offer of type $\hat{x}$, is given by

$$\alpha^*(\hat{x}) = V'(\hat{x}) \qquad (18)$$

and

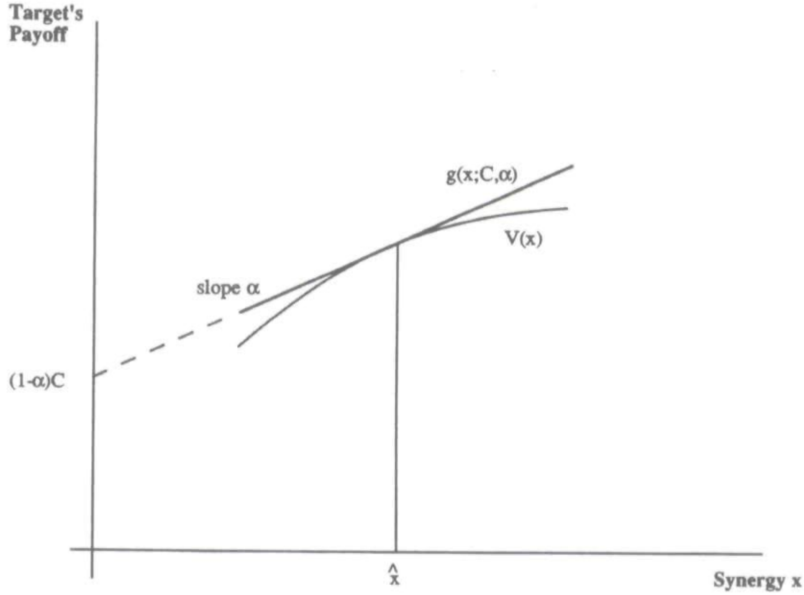

Figure 2
Separating equilibrium with a continuum of types
$V(x)$ is the target's symmetric-information payoff if the bidder is type x while $g(x;\, C,\, \alpha)$ is the target's payoff from the bid $\{C,\, \alpha\}$ if made by type x. The necessary conditions for a separating equilibrium with symmetric-information payoffs are that each type $\hat{x}$ offer $\{C^*(\hat{x}),\, \alpha^*(\hat{x})\}$ such that $g(\hat{x};\, C^*(\hat{x}),\, \alpha^*(\hat{x})) = V(\hat{x})$ and $g(x;\, C^*(\hat{x}),\, \alpha^*(\hat{x})) > V(x)$ for $x \neq \hat{x}$, that is, $g(x;\, C^*(\hat{x}),\, \alpha^*(\hat{x}))$ be tangent to $V(x)$ at $\hat{x}$.

$$C^*(\hat{x}) = [V(\hat{x}) - \hat{x}V'(\hat{x})]/[1 - V'(\hat{x})] \tag{19}$$

From Equations (9) and (10) it can be seen that $\alpha^*(\hat{x})$ and $C^*(\hat{x})$ correspond to α^* and C^*, respectively. It can be verified that $C^*(\cdot)$ is a monotonically increasing function and $\alpha^*(\cdot)$ is a monotonically decreasing function.

We show below that a sufficient condition for the target's payoff from rejection in the separating equilibrium to be the same as that under symmetric information is that $V(b) < a$. If this condition holds, the target is always better off accepting the value of the second highest bidder in actual competition. Consequently, the value from rejection in the separating equilibrium (when the type of the current bidder is revealed) can be written as

$$V(x) = \delta r\left[\int_a^x s\, dF(s) + \int_x^b x\, dF(s)\right] + \delta(1 - r)V(x) \tag{20}$$

It also can be shown that $V(x)$ is concave in x under the condition

$V(b) < a$.[13] The following proposition shows that the strategies and payoffs discussed above also constitute a sequential equilibrium.

Proposition 8. *Suppose $V(b) < a$. Then the unique sequential separating equilibrium payoffs are the symmetric-information payoffs, that is, type x pays $V(x)$ in the first period. The equity and cash components of the offer are given by Equations (18) and (19), respectively.*

Proof. The following set of strategies and beliefs constitutes a separating sequential equilibrium with unique payoffs as stated in the proposition. As in Proposition 2, we do not state here the actions and beliefs of players in the off-equilibrium path of actual competition.

1. Type x bidder offers $\{C^*(x), \alpha^*(x)\}$ as given by Equations (18) and (19).
2. Suppose the target is offered $\{C, \alpha\}$ where $\alpha^*(a) \geq \alpha \geq \alpha^*(b)$. Then there exists some $z \in [a, b]$ such that $\alpha = \alpha^*(z)$. The target accepts this offer if $g(z; C, \alpha) \geq V(z)$. When $\alpha > \alpha^*(a)$ the target accepts the offer if $g(a; C, \alpha) \geq V(a)$, and when $\alpha < \alpha^*(b)$ it accepts if $g(b; C, \alpha) \geq V(b)$.
3. Target's set of beliefs: Offers $\{C, \alpha\}$ where $\alpha = \alpha^*(z)$, $z \in [a, b]$, imply type z. Offers $\{C, \alpha\}$ where $\alpha > \alpha^*(a)$ imply type a and offers where $\alpha < \alpha^*(b)$ imply type b.

The proof that these strategies and beliefs constitute a unique separating equilibrium (in payoffs) is similar to that of the two-type case. ■

It can be verified from Equation (13) that V is an increasing function of r. Noting that the condition $V(b) < a$ is equivalent to the condition $V(b) < L$, the proofs that $\partial C^*(x)/\partial r > 0$ and $\partial[C^*(x)/V(x)]/\partial r > 0$ are similar to the proofs of Propositions 4 and 5. Thus, increased potential competition results in greater payoff to the target and in the increased use of cash.

In the case of actual competition, the equilibrium bids are direct extensions of the two-type case discussed in Section 5. We briefly describe the equilibrium bids for the case $V(b) < a$. Type a bids

[13] This condition is satisfied if δ and/or r are low enough. If this is not the case, that is, if $V(b) > a$, the value from rejection under a separating equilibrium may not equal the value from rejection under symmetric information. With asymmetric information, the type of the highest bidder in actual competition is unknown to the target (except in the two-type case). Therefore, it might accept a bid under asymmetric information that it would have rejected under symmetric information. However, as long as the value from rejection under asymmetric information is a concave function of the type, the main result of our article (that a cash offer implies a higher type) and the comparative statics hold. In fact, as long as the value from rejection is concave over some range of x and some separation occurs, it can be shown that higher types offer more cash in equilibrium. Proofs of the above statements can be obtained from the authors upon request.

either $\{0, 1\}$ or $\{\alpha, 0\}$. Type $x > a$ bids $\{C + \epsilon, 0\}$ if the cash component of the last bid is C and if $C < x$. It stops bidding if the cash component of the last bid is greater than or equal to x or if there is no competing bid with cash component greater than or equal to its last bid. The target's strategy is as follows. Suppose the bid with the highest cash component is $\{C, \alpha\}$. The target accepts it provided $C \geq a$. All other bids are rejected.

Therefore, when the model is extended to a continuum of types, actual competition results in all but the lowest type making all-cash offers. Equity offers and mixed offers are not observed in equilibrium.

6.2 Pooling equilibria

We now consider pooling equilibria when the value from rejection is less than a.[14] Suppose a stationary pooling equilibrium exists in which all bidders make the same bid $\{\underset{\sim}{C}, \underset{\sim}{\alpha}\}$ in each period if there is no competition, and the target's belief about the distribution of types coincides with the actual distribution F. Let $g(x; \underset{\sim}{C}, \underset{\sim}{\alpha})$ represent the symmetric-information value of this offer if made by type x. Then the payoff to the target from rejecting the bid $\{\underset{\sim}{C}, \underset{\sim}{\alpha}\}$ is

$$V_p \equiv \int_a^b \delta r \left[\int_a^x s \; dF(s) + \int_x^b x \; dF(s) \right] dF(x)$$

$$+ \; \delta(1 - r) \max \left\{ V_p, \int_a^b g(x; \underset{\sim}{C}, \underset{\sim}{\alpha}) \; dF(x) \right\} \tag{21}$$

The two terms in the square brackets are the payoffs to the target from actual competition. The last term represents the payoff to the target when no competition arrives in the next period. In this case, the first bidder submits the same bid as before and the target accepts it if it is greater than or equal to the value from rejection. However, in equilibrium, no bidder will make a bid that is less than V_p and be rejected. If it does so, it can possibly gain only in actual competition with a lower type. But even in this case, it has to pay the value of the second-highest bidder, which by our assumption is greater than V_p. Therefore, a necessary condition for the existence of the proposed pooling equilibrium is

$$\int_a^b g(x; \underset{\sim}{C}, \underset{\sim}{\alpha}) \; dF(x) \geq V_p \tag{22}$$

[14] This assumption, which is equivalent to the assumption $V(b) < a$ in Section 6.1, implies that the target is always better off accepting the value of the second-highest bidder in competition. While it simplifies the analysis, the results of this section will hold even if it is relaxed.

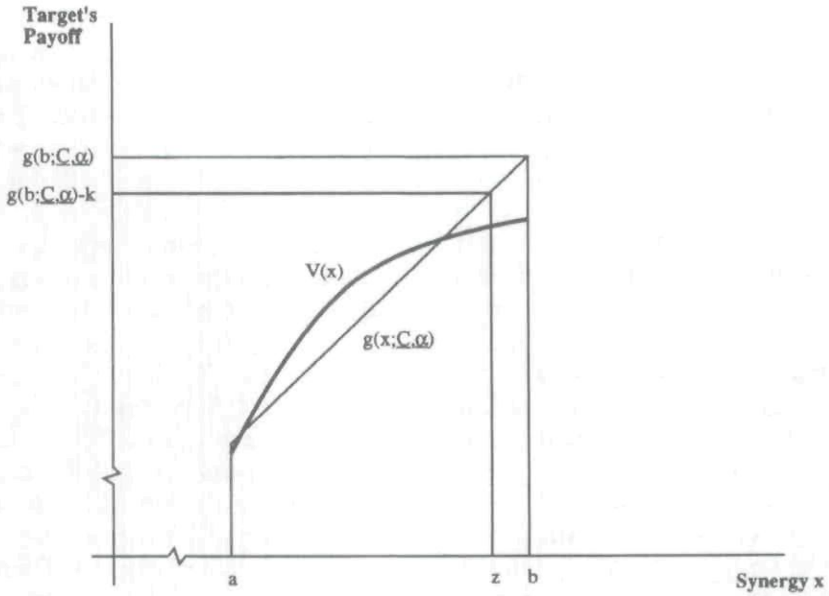

Figure 3
Nonexistence of pooling equilibria
$V(x)$ is the target's symmetric-information payoff if the bidder is type x while $g(x;\ \underset{\sim}{C},\ \underset{\sim}{\alpha})$ is the target's payoff from the pooling offer $\{\underset{\sim}{C},\ \underset{\sim}{\alpha}\}$ if made by type x. Given any pooling offer $\{\underset{\sim}{C},\ \underset{\sim}{\alpha}\}$, there exist values of k such that types in the range z to b benefit from making an all-cash offer of $g(b;\ \underset{\sim}{C},\ \underset{\sim}{\alpha}) - k$. The target benefits from accepting this offer irrespective of its beliefs. This breaks the pooling equilibrium.

That is, the expected payoff to the target from accepting the equilibrium offer is greater than or equal to its payoff from rejecting the offer. Define V as follows:

$$V \equiv \int_a^b V(x)\ dF(x)$$

That is, V is the expected payoff to the target under symmetric information. Using Equations (20), (21), and (22) it can be shown that (22) is equivalent to

$$\int_a^b g(x;\ \underset{\sim}{C},\ \underset{\sim}{\alpha})\ dF(x) \geq V \tag{23}$$

Consider the pooling offer where Equation (23) holds as an equality. As illustrated in Figure 3, Equation (23) and the concavity of $V(x)$ imply that $g(x;\ \underset{\sim}{C},\ \underset{\sim}{\alpha})$ must intersect $V(x)$ at least once and at most twice. The argument that follows applies to the case illustrated in Figure 3 or when $g(x;\ \underset{\sim}{C},\ \underset{\sim}{\alpha})$ intersects $V(x)$ from above. A similar argument can be made if $g(x;\ \underset{\sim}{C},\ \underset{\sim}{\alpha})$ intersects $V(x)$ from below.

We now show that the proposed pooling equilibrium cannot exist. Consider an all-cash offer whose value is $g(b; \underline{C}, \underline{\alpha}) - k$, where k lies in the interval $(0, g(b; \underline{C}, \underline{\alpha}) - V(b)]$. There exist values of k for which the target is better off accepting this offer irrespective of its beliefs. To show this, suppose the target believes that the offer was made by type b. The payoff from rejecting the offer is

$$\delta r \int_a^b s\, dF(s) + \delta(1 - r) g(b; \underline{C}, \underline{\alpha}) \tag{24}$$

The expression above is less than $g(b; \underline{C}, \underline{\alpha})$. This is because the unique fixed-point solution to the equation

$$h(\cdot) = \delta r \left[\int_a^x s\, dF(s) + \int_x^b x\, dF(s) \right] + \delta(1 - r) h(\cdot)$$

is $V(\cdot)$, as can be seen from Equation (20). Since $g(b; \underline{C}, \underline{\alpha}) > V(b)$ and $\delta(1 - r) < 1$, it follows that $g(b; \underline{C}, \underline{\alpha})$ is greater than the expression in Equation (24). Therefore, there exists some value of k for which the all-cash offer $g(b; \underline{C}, \underline{\alpha}) - k$ dominates the payoff from rejection. If this is true when the target believes the bidder to be type b, then the same offer will dominate the payoff from rejection for any other belief system, since the value from rejection is a monotonically increasing function of the perceived type. Types greater than z, where z is the type for which $g(z; \underline{C}, \underline{\alpha}) = g(b; \underline{C}, \underline{\alpha}) - k$, are better off making this cash offer. This breaks the proposed pooling equilibrium. If the pooling equilibrium can be broken when Equation (23) holds as an equality, it can be broken when it holds as an inequality. The same argument can be used to break any semipooling equilibrium where pools are formed by connected sets of types.

7. Conclusions

In this article, we provide an asymmetric-information model with competition to analyze the interaction between the informed bidders and the uninformed target. The dynamic structure of the model enables us to derive the following empirical implications regarding competition, sharing of the synergy, and the medium of exchange.

1. In takeovers financed with a mixture of cash and equity, the higher the amount of cash, the higher the abnormal returns to stockholders of both the acquirer and the target.

2. The fraction of synergy captured by the target decreases with the level of total synergy. Moreover, the higher the cash component, the lower the fraction of synergy captured by the target.

3. The dollar amount of synergy captured by the target increases with the level of total synergy and the level of the cash component.

4. As competition (actual or potential) increases, the fraction of synergy captured by the target increases. Also, the target's payoff is higher when there is actual (rather than potential) competition.

5. As potential competition increases, the amount of cash used in financing takeovers increases. Furthermore, the amount of cash as a proportion of the total offer increases if the target's payoff is a concave function of the synergy.

6. In the case of actual competition, all but the lowest type make all-cash offers. Hence, all-cash offers are more probable than all-equity offers or mixed offers (as long as the distribution of types does not have a mass point at the lowest type).

Appendix

Proof of Proposition 1

Case 1: L > V(h).

- From Equation (2), $\alpha(h) = \delta r[q(L/H) + 1 - q]/[1 - \delta(1 - r)]$.
- From Equation (5), $\alpha(l) = \delta r/[1 - \delta(1 - r)]$.

Since $L/H < 1$, $\alpha(h) < \alpha(l)$.

Case 2: L ≤ V(h). From Equations (1) and (4),

$$\alpha(h) = (D/H)[qV(h) + (1 - q)H] \quad \text{and}$$
$$\alpha(l) = (D/L)[qL + (1 - q)V(h)]$$

where $D \equiv \delta r/[1 - \delta(1 - r)]$. Each term of $\alpha(h)$ is less than the corresponding term of $\alpha(l)$.

From Equations (1) and (4) it can be seen that $V(h) > V(l)$. ∎

Proof of Proposition 4

Define $V'(h) \equiv \partial V(h)/\partial r$ and $V'(l) \equiv \partial V(l)/\partial r$. From Equation (10), $\partial C^*/\partial r$ is proportional to

$$\frac{[V(l)H - V(h)L][V'(l)(H - C^*) - V'(h)(L - C^*)]}{C^*} \tag{A1}$$

By Proposition 1, $[V(l)H - V(h)L] > 0$. Therefore, to prove the proposition, it needs to be shown that the second term in (A1) is positive. We shall show this for the case $L > V(h)$ and leave the rest of the proof to the reader.

- From Equation (2), $V'(h) = \delta(1 - \delta)[qL + (1 - q)H]/[1 - \delta(1 - r)]^2$.
- From Equation (5), $V'(l) = \delta(1 - \delta)L/[1 - \delta(1 - r)]^2$.

Therefore, $V'(l)(H - C^*)/(L - C^*) > V'(l)H/L > V'(h)$. The first inequality follows from simple algebra and the second follows from the expressions for $V'(h)$ and $V'(l)$. ■

Proof of Proposition 6

If competition develops, the following strategies and beliefs constitute a sequential equilibrium:

I. Type l bidder's final find is $\{0, 1\}$.

II. Type h bidder's final bid is $\{\max[V(h), L], 0\}$ if no competitor makes an offer with cash component greater than L. Otherwise, it is $\{H, 0\}$.

III. Target's strategy is as follows:
   1. If at least two final offers have cash components greater than or equal to L, accept the one that maximizes $C + \alpha(H - C)$ provided this value is at least equal to δH. Otherwise, reject all offers.
   2. If only one of the offers $\{C, \alpha\}$ has a cash component greater than or equal to L, accept it if $C + \alpha(H - C)$ is at least equal to $V(h)$. Otherwise, reject all offers.
   3. If all final offers have cash components less than L, accept the one that maximizes $C + \alpha(L - C)$ provided this value is at least equal to δL. Otherwise, reject all offers.

IV. The beliefs (target's and the competitors) are as follows: cash component greater than or equal to L implies type h and cash component less than L implies type l.

It is not difficult to see that the above strategies and beliefs constitute a separating equilibrium. Given the strategies of the other players, type l has to offer the entire synergy to the target to win. Therefore, it can do no better than offering $\{0, 1\}$. Type h, as long as it believes the competitor is type l, will try to outbid it by making cash offers of L. It cannot make winning offers with a cash component less than L since such offers will be challenged by type l. If $V(h) < L$, the lowest winning offer for type h competing with type l is $\{L, 0\}$. If $V(h) \geq L$, the target will accept only offers of perceived value at least $V(h)$. Also, bidding $\{0, 1\}$ to mimic type l is more expensive than bidding $\{\max[V(h), L], 0\}$. If type h faces a competitor of the same type all the synergy is retained by the target and hence it has to bid h in cash.

If the target receives two bids with a cash component greater than or equal to L it believes both bidders to be type h. Its expected payoff from rejecting these offers is δH since these bidders will compete again in the next period and bid up the offer to H. Therefore, it will accept no bid less than δH. Similarly, if the target receives two bids with a cash component less than L, it will accept no bid less than δL. If it receives only one bid with a cash component greater than L, it believes that bidder to be type h and all other bidders to be type l. In this case, its expected payoff from waiting is $V(h)$. Hence it will accept only bids with perceived value greater than $V(h)$.

This equilibrium outcome may be supported by other strategies. For example, if $V(h) < L$, type l can bid $\{L, 0\}$. Similarly, if $V(h) \geq L$, type h can offer a mixture of cash and equity such that $C \geq L$ and the total value of the offer is equal to $V(h)$. However, the payoffs to the bidders and the target are unique. This is obvious when similar types compete. If type h and type l compete the outcome cannot be below L and since separation occurs, type h has to pay $V(h)$. ■

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