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Value-Maximizing Managers, Value-Increasing Mergers, and Overbidding

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Abstract

Some acquisitions can be viewed as the quickest means to obtain a scarce resource required for restructuring in response to an economic shock. Such acquisitions can give the acquirer a competitive edge and hurt its competitors. In this paper, I first show that if a firm will be adversely affected by a competitor's acquisition, then it can rationally "overpay" for the target to avoid this outcome within a value-maximizing framework due to industry equilibrium effects. Next, I show that depending on the level of anticipation by the market, the magnitude of the cost of losing, and the competition between bidders, an acquirer can earn negative payoffs at the announcement of such an acquisition. Even though the merger is the best decision given the circumstances, negative returns incorporate the understanding that the target is a necessary resource to survive in this changing environment, losing it to a rival is costly, and there is a positive probability that the bidder may not win or win by paying more than the synergy value of the target. Finally, I extend the model to include 2 targets that become available *sequentially* to multiple bidders and show that when there are alternatives available for the target's resources, overbidding subsides.

I. Introduction

> The contest that may best exemplify the critical difference between winning or losing, the primary driver of the bitterest battles, is the high-profile, mega-bucks scrap between CSX and Norfolk & Southern to own Conrail. To the victor belongs dominance in railroad freight hauling in the eastern U.S.; the loser may face an uncertain future as a competitive also-ran.[1]

On October 23, 1996, 8 days after Conrail announced that it had agreed to a friendly takeover by CSX, Norfolk Southern launched a hostile bid for Conrail,

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[1] Sikora, M. (ed.). "Immovable and Irresistible." *Mergers & Acquisitions*, 31 (1997), p. 3.

sparking a takeover battle. After an 8-month bidding contest, the 2 companies finally agreed to a joint acquisition of Conrail. By the end of this takeover battle, Conrail's stock, which began at $69¾, was valued at $115, representing a 64% premium over its preannouncement stock price. The high premium paid to Conrail is typical of a more recent trend that is also captured by negative returns to acquirers.[2] In addition to recent empirical studies linking these returns to several firm and transaction-specific characteristics,[3] negative acquirer returns have also been theorized to result from value-decreasing and irrational decisions made by self-interested (Jensen (1986), Shleifer and Vishny (1989)) or overconfident (Roll (1986)) managers of the acquiring firms. The primary goal of this paper is to create an alternative theoretical framework with rational and value-maximizing managers in which acquirers "overbid" and earn negative returns due to competitive forces in their industry, as in the case of Conrail.

The key assumption of my approach is that losing the target to a competitor is costly. Instead of simple corporate investments, mergers are interpreted as the acquisitions of resources required to efficiently react to a changing economic environment. By acquiring the target firm's resources, the acquirer gains a competitive edge and challenges the rival's market share or the expectations of future profits.[4] The academic basis for such a framework is rooted in the early studies of Eckbo (1983), (1985) and Stillman (1983) as well as the recent trend in empirical studies that successfully link merger activity to industrywide economic changes (Mitchell and Mulherin (1996), Andrade and Stafford (2004)). These studies agree that most of the mergers and acquisitions (M&As) are associated with technological or regulatory shocks and that industries react to these shocks by restructuring, often via M&As. After an industry shock, investment opportunities available to firms are subject to change, and returns to the status quo are not guaranteed. The main implication of interpreting mergers in this manner is that an acquisition affects not only the acquirer but also its rivals, since these restructuring efforts help shape the postshock industry structure.

This can be seen in the case of the railroads. In the early 1990s, railroads were losing business to the trucking industry, and high costs were preventing them from lowering prices and competing more effectively. In response to the changing conditions, the railroads started consolidating as a means to cut costs through the elimination of duplicate operations. Following the lead of western railroads, the 3 major eastern railroads, Conrail, Norfolk Southern, and CSX, joined in the consolidation wave. As a result, the high premium paid to Conrail reflected not

[2]Many researchers studying wealth gains find that acquirers at best earn 0 returns, while some document statistically negative returns at announcement. Jensen and Ruback (1983) document bidder returns for the 1960s and 1970s; Jarrell, Brickley, and Netter (1988) for the 1980s; and Andrade, Mitchell, and Stafford (2001) for the 1990s.

[3]Recent findings show that average bidder announcement returns are significantly positive when the bidders are relatively small (Moeller, Schlingemann, and Stulz (2004)) and when the target is a private firm (Fuller, Netter, and Stegemoller (2002)), regardless of the method of payment used by the acquirer. See Eckbo (2009) for a recent survey on the sources of acquirer announcement returns.

[4]Jehiel and Moldovanu (1996) and Jehiel, Moldovanu, and Stacchetti (1996) show how such negative externalities among buyers can lead to "overbidding" in a general auction setting. I apply the idea specifically to a merger setting and also extend it to study the impact of having 2 sequential targets on the optimal bids of the potential bidders.

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only the incremental value Conrail added to the 2 other railroads, but also the high cost of losing Conrail to the competitor. As is typical, the financial projections of both CSX and Norfolk Southern for the proposed merger with Conrail each included the cost reductions due to the merger as well as the revenues that would come at the expense of the losing competitor. Most importantly, however, they each included the "cost of losing," which was estimated as the loss in revenues that would be a direct result of losing Conrail to the competitor.[5]

With this primary assumption in hand, I address several fundamental questions about merger activity within a rational and value-maximizing framework. First, I show that bidders are willing to systematically overpay for targets by submitting bids that are greater than their synergy values in bidding contests. If losing the target to a rival firm will impose a cost, then paying more than the synergy and winning the target can minimize this cost. Then, by endogenizing the decision to initiate a merger even before submitting bids, I show that firms may choose to invest in mergers even when they are value decreasing on average. Moreover, I show that one can observe negative returns at announcement depending on the size of the loss suffered by the losing bidder, the level of competition, and the market's information set. Although the ultimate payoffs are independent of the market's information set, observed announcement returns and their interpretation as a measure of the merger's true economic impact differ depending on whether the market anticipates the possibility of the merger prior to the announcement or not.

One factor directly affecting the payoffs of the bidders is the cost of losing the target firm. More specifically, results show that the higher the cost of losing, the less likely it is for the bidders to initiate mergers. However, conditional on the merger being initiated, the higher the cost of losing, the lower the ex post payoffs of both the successful and the unsuccessful bidders. The level of competition is another factor affecting the payoffs of the bidders. Obviously, this depends both on the number of rival bidders as well as the number of available targets. Competition is most fierce and the payoffs are the worst when there is only 1 available target and both bidders choose to compete. Allowing for 2 identical targets with similar resources that become available to bidders sequentially curbs this effect a bit for the 1st target. Bidders are willing to pay less for the 1st target than they are for the 2nd target even though their private value for both targets is the same.

This paper differs from the other approaches that address negative announcement returns to acquirers using rational and value-maximizing frameworks. For example, if a bidding firm already owns part of the target, then it can rationally bid more than its synergy value to acquire the rest (Burkart (1995)). Other studies attribute the negative announcement returns to bidders as information revelation about the prospects of the acquiring firm itself (McCardle and Viswanathan (1994)) or the prospects of its industry as a whole (Jovanovic and Braguinsky (2004)). Similarly, others suggest that stock as the financing choice signals bidder overvaluation (Myers and Majluf (1984), Travlos (1987)) and leads to negative returns at the announcement of such mergers. Morellec and Zhdanov (2005) use

[5] See Esty, Flees, and Millett (1998).

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real-options techniques primarily to determine terms and timing of takeovers, also showing that negative returns to bidders are possible in the presence of competition coupled with imperfect information.

In my model, bidders are symmetric and do not have initial stakes in the target company. Nor do they pay the target with their own stock. I also do not directly model a signaling framework. However, the dependence of the magnitude of the market reaction on partial anticipation may suggest an indirect link to such stories. Closest in spirit to my model are Molnár (2008) and Fridolfsson and Stennek (2005), who develop theories of preemption. While Molnár and I share similarities in some of our conclusions, our modeling approaches differ. In addition, I extend the model to study the bids when there are multiple targets available sequentially to bidders and address the issue of a negative market reaction in the presence of rational investors and efficient markets. On the other hand, Fridolfsson and Stennek attempt to explain why mergers reduce profits and raise share prices, while I try to show how relatively more profitable mergers can occur and lead to negative stock price reactions.

The rest of the paper is structured as follows. Section II specifies the model, and Section III derives the bidders' equilibrium strategies and delineates the outcomes that emerge as a result of different realizations of the synergy values within the strategic equilibrium. Section IV shows how various payoffs as well as market reaction for acquirers may range from negative to positive depending on the parameters. Section V examines how the presence of multiple targets affects the equilibrium bids. Section VI extracts the empirical implications of the model, and Section VII concludes. All proofs are contained in the Appendix.

II. The Model

A. Basic Setup

There are 2 potential acquirers (bidders), B_i and B_j, of 1 target firm. The target firm is assumed to be passive and by normalization accepts the best nonnegative bid.[6] Both bidders have privately observed valuations of own synergy, S_i and S_j, to be gained upon acquiring the target, and they strive to maximize shareholder value. While the realized value of the synergy is private information, the distribution is common knowledge. Specifically, the synergy valuations S_i and S_j are distributed independently and uniformly on the interval $[0, 1]$. Note that the assumption of private synergy values avoids inferences of irrational behavior by managers due to hubris (Roll (1986)), and the value-maximizing assumption excludes other agency-theoretic issues previously tied to acquiring firm managers (Shleifer and Vishny (1989), Jensen (1986)), while positive support for the synergies ensures that all mergers increase value and are synergistic (Andrade et al. (2001), Mulherin and Boone (2000)).

Each bidder has 2 choice variables. The first is whether to initiate a merger with the target where this initiation decision is represented by the binary functions,

[6]The target is not modeled as a strategic agent. However, the assumed behavior is consistent with a normalized reservation price of 0 in all contingencies.

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$\tau_i(S_i)$ and $\tau_j(S_j)$. If bidder B_i initiates a merger after observing the synergy valuation S_i, then $\tau_i(S_i)=1$, and if not $\tau_i(S_i)=0$. The same rule applies to bidder B_j. The initiation decision is meant to capture the initial willingness to acquire a particular target before deciding on how much to bid for it in a possible contest. The other choice variable for the bidders is the bid price for the target. I let $b_i(\tau_j;S_i)$ represent B_i's bid in a possible auction at $t=2$ when his opponent chooses $\tau_j \in \{0, 1\}$ as its merger initiation decision. Each player's initiation decision is publicly observed before bids are announced. Thus, B_i is allowed to choose different bids based on the new information about his opponent's initiation decision: $b_i = b_{i1}$ when $\tau_j = 1$, and $b_i = b_{i0}$ when $\tau_j = 0$. Similarly, $b_j(\tau_i;S_j)$ is the opponent's bid when player i chooses $\tau_i \in \{0, 1\}$. Bidder j follows the same rule for his choice variable as well.

The game is formulated in 2 stages. At $t = 1$, bidders discover their private synergy types, after which they simultaneously decide whether to initiate a contest for the target (bidders choose τ_i and τ_j).[7] If at least 1 bidder initiates, there is a contest in the form of a 2nd-price auction at $t=2$. Bidder i (j) chooses b_i (b_j), the amount to bid for the target in the auction. When no bidder initiates at $t = 1$, there is no auction and the game ends.

B. Payoffs

The payoffs of the players are specified as follows. If there is no initiation by either bidder, the target stays independent and both bidders receive normalized payoffs of 0. If either player initiates a merger, then bidders compete for the target in the form of a modified 2nd-price auction, which is described later. There is no cost incurred by bidders to observe their synergy values or for bidding in the auction.

After the bidders make their initiation decisions, 4 possible outcomes can be realized at $t = 1$: i) both B_i and B_j initiate a merger; ii) B_i does not initiate, but B_j does; iii) B_i initiates, but B_j does not; and iv) neither B_i nor B_j initiates. Three of these 4 outcomes (i–iii) result in an auction. In an auction, the bidder with the higher bid wins and pays the losing bidder's bid. When the bids are equal, the target randomizes with ½ probability between accepting the offers of the 2 bidders. The losing bidder earns a negative payoff of $-\alpha$ where $\alpha > 0$. This may be thought of as an industry-specific cost for falling behind in competition, which is common across firms. Let A_i represent the payoff of B_i in a potential auction at $t=2$. Then, with general bid functions given by b_i and b_j, bidder B_i's payoff in an auction is given by

$$A_i = \left\{ \begin{array}{cc} S_i - b_j, & b_i > b_j; \\ -\alpha, & b_i < b_j; \\ \tfrac{1}{2}(S_i - b_j - \alpha), & b_i = b_j. \end{array} \right\}$$

There are 3 relevant terms in this payoff A_i. The 1st term captures the case in which B_i has the higher bid (i.e., $b_i > b_j$), and thus his payoff is his synergy value

[7] Note that the simultaneity of the initiation decisions does not impose any restrictions along the time component; it simply ensures that bidders do not observe the rival's initiation decision before they make their own, regardless of the chronological order or the lag between the 2 decisions.

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S_i net of player B_j's bid price.[8] The 2nd term reflects the outcome in which B_i is outbid by B_j (i.e., $b_i < b_j$), and thus B_i incurs the loss of α as he relinquishes the competitive edge to B_j. The 3rd and final term denotes the case in which B_i and B_j each bid the same price for the target, who then with equal probability selects either B_i or B_j as the winner. Thus, ½ of the time B_i wins and earns $S_i - b_j$, and the other ½ of the time B_i is not selected and loses α.

The main difference of this game from the traditional 2nd-price auction is that in this game losing is costly. In the traditional 2nd-price auction, the losing bidder guarantees himself a payoff of 0. Otherwise, bidders might choose not to participate in the auction at all. In this model, the losing bidder earns a negative payoff of $-\alpha$, capturing the effect of the winning bidder gaining a competitive advantage over his competitor. This negative payoff is defined as the cost of losing the target and is imposed on the losing bidder even if it chooses to abstain from an auction that is initiated by the competitor. Consequently, the bidders cannot avoid this outcome by simply not participating.[9]

The key feature of the model is that even though the rivals do not observe each other's initiation decisions before making their own, their actions are *not independent* of each other. The interdependency of payoffs and costly losing means that their strategies are very much dependent and simply best responses to their beliefs about the opponent's strategy. The equilibrium concept employed for solving the game is pure-strategy Bayesian-Nash equilibrium (BNE) that survives 1 round of elimination of weakly dominated strategies. After the elimination of the strategies that ultimately involve bids less or greater than the synergy plus the cost of losing, the BNE with 1 round of elimination produces 2 symmetric equilibria, as shown in the next section.

III. Equilibrium Strategies

Below, I analyze the equilibrium strategies of bidders with respect to their choice variables, which include their initiation decisions and auction bids. The relatively simple framework employed in this paper proves to be sufficiently rich to address the 2 fundamental questions about mergers: i) Why do some acquirers apparently overbid in bidding contests?, and ii) Why and when do these firms initiate mergers? It is, in fact, the 2-stage structure of the model and the assumption of a changing environment that allows such an examination.

[8]Recall that this is a 2nd-price auction.

[9]The bidding contest here is modeled as a 2nd-price auction. A more common form of auction that is used to model takeover contests is an English auction among bidders (e.g., see Burkart (1995)). While an adjusted form of the English auction better represents the real-life acquisition procedure, a 2nd-price auction is used in this model simply for increased tractability. However, in a private-values model in which both bidders know their exact values for the target and their valuations are statistically independent as they are in this model, the English and 2nd-price auctions are strategically equivalent (see Milgrom and Weber (1982)).

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A. Bids and Competition

In a single-unit 2nd-price auction without costly losing, it is a weakly dominant strategy for a bidder to bid up to his valuation for the object. The outcome is analogous in this case. Costly losing dictates that once a competitor initiates a contest, a bidder's effective valuation of the target cannot simply be the synergy value but the sum of the synergy value *and* the loss imposed on him if he fails to acquire the target. After the opponent chooses to initiate a merger, both abstaining from and losing the auction guarantee the bidder a negative payoff ($-\alpha$). Therefore, once an auction is initiated, a bidder's updated value for the target becomes $S_i + \alpha$. This intuition is formalized in the following result.

Theorem 1 (Auction Bids). When only 1 target is available for acquisition and a contest has already been initiated by either B_i, B_j, or both bidders, a player (B_i or B_j) always enters the auction and bids an amount equal to the sum of his synergy and the cost of losing. Thus, bidder B_i bids $b_{i1} = b_{i0} \equiv b_i = S_i + \alpha$ and bidder B_j bids $b_{j1} = b_{j0} \equiv b_j = S_j + \alpha$.

Now that one knows the equilibrium bids, one can solve for the expected payoff of the bidders in the auction and discuss the implications of the model about the competition between bidders. The first thing to note about the payoffs is that bidders cannot avoid paying α regardless of the outcome of the auction. To illustrate, assume that B_i loses the contest. Then, as the losing bidder he earns a negative payoff of $-\alpha$. Now assume instead that B_i wins the auction. In that case, he pays $b_j = S_j + \alpha$ for the target and earns an ultimate payoff of $S_i - S_j - \alpha$. Thus, the expected payoff of the auction for B_i is

$$\mathrm{E}_i[A_i] \quad = \quad \int_0^{S_i} (S_i - S_j) f(S_j) dS_j - \alpha,$$

where $f(S_j)$ is the unconditional density of the random variable S_j. A similar expression applies to B_j.

Not surprisingly, one prediction is that the arrival of a competing bid is bad news for the initial bidder. Competition causes the initial bid to be revised and leaves the initial bidder with 2 options: Lose the target or buy it at a higher price. Neither of these alternatives should be desirable for the initial bidder if it still believes the target firm is valuable. This should cause a negative reaction for the initial bidder at the announcement of the competing bid if this was not already anticipated.[10] The implication that the initial bidder is hurt from subsequent competition is not necessarily unique to a model that includes "a cost of losing" the

[10]There is some evidence from earlier studies that competition from additional bidders has a negative effect on the initial bidder, particularly if he loses the target to a competitor. For example, Bradley, Desai, and Kim (1988) show that competition results in higher payoffs for target firms. In a more direct setup, Bradley, Desai, and Kim (1983) show that the initial bidders experience negative returns at the announcement of a competing bid that the target firm eventually accepts. However, recent studies on this issue provide mixed evidence: Betton, Eckbo, and Thorburn (2009) show that bidder returns are not significantly lower when there are multiple bidders competing for 1 target, whereas Cai, Song, and Walkling (2010) show that they are.

target firm.[11] However, this assumption produces novel predictions on the *challenging* bidders.

First, if losing the target is costly, then the announcement of a merger by the initial bidder should have a negative impact on the price of any potential rival bidder. Second, by examining the expected payoff of the auction, one can predict that the announcement of a proceeding competing bid always has a positive effect on the price of the challenging bidder. To see this, suppose that B_j has already initiated a merger. If B_i abstains from bidding, he is guaranteed a payoff of $-\alpha$. If he enters the auction, his expected payoff is at least $-\alpha$. As B_i already faces $-\alpha$ after the initial bid, the possibility of a payoff that is at least less negative would be positive news for the competing bidder, and the stock price should increase upon entry if this was not already anticipated.

B. The Merger Initiation Decision

With the equilibrium bidding behavior in hand, one now steps back to the original decision of whether to initiate a merger. If initiating a merger attracts competition and as such introduces the possibility of realizing a worse payoff than achieved in the initial no-merger equilibrium, why do firms initiate mergers at all? Thinking of mergers simply as investments in a static corporate environment makes it difficult to address this question within a rational framework. In such an environment, the outside option of bidders is exogenously specified to be the status quo. Regardless of the opponent's action, a bidder can thereby guarantee himself a payoff of 0 by not taking any action at all. To take on an investment, a firm in isolation simply looks at the net present value (NPV) of the project benchmarked to the status quo, which in this context corresponds to its synergy value. If it is positive, $S_i > 0$, a bidder initiates a merger; if it is negative, he does not.

In a changing environment with interdependent payoffs between rivals and costly losing, the expected payoff of not taking any action is not constant and can be negative, as it is endogenously determined at each stage by the opponent's actions. Naturally, an acquisition in this model cannot simply be thought of as being a positive NPV project benchmarked to 0. At $t = 1$, after the opponent initiates, the payoff of no action (or not entering the contest) is $-\alpha$; hence, the appropriate benchmark is the state in which a bidder fails to acquire the target whose payoff is $-\alpha$. Similarly, before initiation decisions are made, at $t = 0$, the expected payoff of not initiating is not 0 but dependent on the probability that the opponent initiates the auction. This feature of the model allows me to endogenize the merger decision and study when a bidder decides to change the current state by initiating a merger.

Theorem 2 (Initiation Decision). There are 2 pure-strategy equilibria, each with its own symmetric cutoff points, $S_c = 2\alpha$ and $S_c = 0$, where bidders (B_i or B_j) initiate a merger whenever their synergy values (S_i or S_j) exceed these cutoffs,

[11] Morellec and Zhdanov (2005) recently show how negative returns may accrue to the acquiring firm from competition with no parallel predictions on the rival firms.

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and do not initiate otherwise. In what follows, the equilibrium in which $S_c = 2\alpha$ ($S_c = 0$) is referred to as the "strategic equilibrium" ("aggressive equilibrium").

The 2 different equilibria may be interpreted as corresponding to different types of situations in which the firms interact more aggressively versus more strategically. For example, in a situation where firms initiate whenever they have a positive synergy value, that is, the cutoff is given by $S_c = 0$, the firms are more aggressive, ignoring the strategic impact of losing the target to a competitor. The intuition is that if a player believes that his competitor will always initiate a merger regardless of his synergy value, it is a rational best response for him to simply do the same. On the other hand, the firms in the strategic equilibrium (where the cutoff is $S_c = 2\alpha$) take into consideration the competitive environment and the consequences of losing the target to a rival bidder.

Intuitively, 2α represents the sum of 2 components. The 1st component is the guaranteed payment of α either as a losing or winning bidder: If the bidder loses, his payoff is $-\alpha$, and if he wins, his payoff is his synergy minus the rival's bid, $S_i - S_j - \alpha$. In both cases he loses at least an amount equal to α with certainty. The other component is simply the expected value of the opponent's synergy given that he does not initiate a merger and loses the auction (i.e., $\mathrm{E}_i[S_j | S_j < 2\alpha] = \alpha$).

C. "Strategic" Equilibrium Outcomes Under Various Synergies

For the remainder of the analysis, I will focus primarily on the outcomes and payoffs of the strategic equilibrium while discussing any potential differences that arise from those of the aggressive equilibrium whenever applicable. However, it is worth noting that the payoffs for acquirers will be even more negative in the aggressive equilibrium given that bidders initiate all the time regardless of their expected payoffs. Later, I begin by showing the range of synergy values for which the expected payoff of the auction is negative, though bidders still initiate mergers. Then, I show the range in which "dormant" mergers exist, where both bidders have positive synergy values but no merger takes place.

Corollary 1 (Expected Payoff of the Auction). The expected payoff of the auction for B_i is positive if and only if $S_i > \sqrt{2\alpha}$. Therefore, if the realized synergy value of bidder B_i is in an intermediate range such that $2\alpha < S_i < \sqrt{2\alpha}$, then he initiates a merger even though the expected payoff of the auction is negative.[12] An analogous result holds for bidder B_j.

One thing to note from the analysis of the previous section is that the expected value of not initiating a merger is not 0, and in fact is negative for the symmetric equilibria documented in Theorem 2. In other words, if $S_i > 2\alpha$, bidder B_i will initiate a merger, but that would not guarantee that the expected payoff of the auction is positive; only that the expected payoff of the auction is at least

[12]For $\alpha < ½$, which is the only region in which mergers are initiated, $2\alpha < \sqrt{2\alpha}$ always holds true: If $\alpha > ½$, then $S_c = 2\alpha > 1$, which is the upper bound for synergy values, and no mergers are initiated.

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less negative than that of not initiating. Corollary 1 shows that for low synergy values, the expected payoff of the auction is in fact negative, yet bidders initiate mergers since the expected payoff of not initiating, which depends on the opponent's action, is even worse.

Corollary 2 ("Dormant" Mergers). If the realized synergies of both bidders are such that $S_i, S_j \in (0, 2\alpha)$, then no merger is initiated, even though both bidders (B_i, B_j) can create positive synergies with the target.

On the other end of the spectrum, there exist regions in which both bidders have positive synergy valuations for the target and neither initiates a merger. Here, the magnitudes of the synergy values are too low. Initiating leads to a significant risk of having a competitor with a higher valuation step in and steal the target, leaving the original bidder with a negative payoff of $-\alpha$. With a low synergy value, even a winning bidder is more likely to earn negative payoffs by giving away all the value created and more to the target through competitive bidding with the rival bidder. Consequently, the bidders avoid starting a bidding war when their synergy values lie in this lower region, as preserving the status quo provides a more profitable option.[13]

Another empirical regularity in the takeover literature is that mergers occur in waves.[14] By using the results and ideas of this paper in the context of a simple example, one can explain why mergers cluster within an industry and how a slight perturbation can cause firms to move from a no-merger equilibrium to a merger wave. Suppose one has Φ number of bidders competing for the target instead of 2 bidders and the equilibrium cutoff value of synergy above which bidders initiate mergers is $S_{c\Phi}$. In the range $S_i < S_{c\Phi}$, bidder i's expected payoff of preserving the status quo is less negative than the expected payoff of initiating. As long as the no-merger state of the industry is maintained, all players whose synergy values lie in this lower region are better off not initiating a merger. However, once a bidder draws a synergy value that is greater than the cutoff, initiates a merger, and disturbs the industry equilibrium, the outside option of his rivals changes. Now, the expected payoff of not initiating becomes $(-\alpha_\Phi)$ and the expected payoff of initiating becomes *less* negative. This causes all the "dormant" mergers to be activated, causing a merger wave in the industry. Note that, in this model, not all positive economic shocks will start a wave of mergers. Here, it is the shocks combined with an initial move from a competitor that is the source of a potential wave.

One example of how the profitability of the status quo is affected by competitors' mergers and how a wave is triggered can be seen in the consolidation of the airline industry. After the proposed mergers of United Airlines with US Airways and American Airlines with TWA, "[b]oth Delta and Continental have

[13]Note that this is consistent with the results of Jehiel and Moldovanu (1996) and Jehiel et al. (1996), who show that nonparticipation can be optimal in the presence of negative externalities.

[14]Mitchell and Mulherin (1996) show that acquisitions cluster around some industrywide shock in the target industry for the period 1982–1989, whereas Mulherin and Boone (2000) do the same for the period 1990–1999. Andrade and Stafford (2004) show clustering around the bidder industry during the 1990s. More recently, Harford (2005) shows that shocks coupled with liquidity in the capital markets lead to merger waves.

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said they prefer to stay independent, but would consider a merger or some other alliance if competitors' mergers are approved."[15] Clearly, Delta and Continental would gain little or no value from merging in a state where the no-merger equilibrium was preserved by all their competitors. However, the potential mergers would allow their competitors to reduce costs and to operate more efficiently, ultimately changing the form of the competition in the industry against them. This would cause their current profits to fall and for the merger to possibly become a more profitable option.

IV. Acquirer Payoffs and Market Reaction

If the proposed theory is the underlying reason for overpayment in mergers, how does this manifest itself in payoffs and as a negative market reaction? Acquirer and rival payoffs depend on the extent of competition among the bidders and the magnitude of the cost of losing the target firm. However, announcement returns also depend on the market's information set; that is, the level of anticipation of the merger by the market prior to its announcement. In this section, I analyze the effect of these 3 variables (cost of losing, competition, and anticipation) on the ex post payoffs and the market reaction for bidders within 2 distinct types of information flow to the market.

Corollary 3 (Ex Post Negative Acquirer Payoffs). If the realized synergies of the bidding firms are i) $S_j < S_i < S_j + \alpha$, and ii) $S_i \geq S_c = 2\alpha$, then the bidder with the highest valuation, B_i, acquires the target. However, he overpays in equilibrium and earns a negative payoff of $S_i - S_j - \alpha < 0$. The losing bidder, B_j, earns $-\alpha < 0$.

A winning bidder earns a negative payoff if the following 3 conditions are met: First, a merger is initiated by either bidder. This requires the synergy value of the ultimate winner (assume B_i) to be greater than the cutoff value of synergy, that is, $S_i > 2\alpha$ (condition ii), so that a merger is initiated. Second, the winning bidder has a higher synergy value than does his opponent, $S_i > S_j$. This allows him to submit a higher bid than his opponent and ultimately to win the auction. Finally, the acquirer's synergy value is lower than the bid of his rival in the auction, which is his payment for the target firm, $b_j = S_j + \alpha$. The last 2 conditions require S_i to be in the intermediate range, $S_j < S_i < S_j + \alpha$, which is captured in Corollary 3.i.

In fact, it is this last condition, or the magnitude of the difference between the synergy values of the bidders, that determines whether an acquirer ends up with a negative or positive realized payoff. If the synergy valuation of the winning bidder exceeds his rival's by at least an amount equal to α, then he earns a positive payoff. If the difference between the 2 synergy values is less than α, then even the successful bidder obtains a negative payoff of $S_i - S_j - \alpha < 0$, whereas the losing bidder earns an even worse payoff of $-\alpha$ from the acquisition. The implication is that the worst acquirer returns should be observed when the bidders' synergy values for the target are very close in magnitude and when the cost of losing the target is high.

[15] *USA Today* (2001).

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Suppose this (the announcement of the auction bids at $t = 2$) is the first time the market incorporates this information into the stock prices of the acquiring and the rival firms. This would correspond to a state of no anticipation such that the market finds out about the merger only when the final bids are announced. Then returns to successful acquirers would range from negative to positive depending on the magnitude of the synergies and the cost of losing the target. However, given the market's information set, the expected values of these payoffs might already be incorporated into the prices of the bidders prior to the consummation of the merger.

To address that, I next specify 2 distinct structures of information flow to the market: one with the market becoming aware of the possibility of a merger before the announcement and another with the possibility of the merger not being revealed until announcement. In both cases, the announcement of an initiation decision at $t = 1$ (instead of the announcement of the auction bids at $t = 2$) is referred to as the time of the merger announcement. The primary reason for using the initiation decision as the announcement date is that this allows for some uncertainty to remain about the bidders' synergy values after the announcement, providing a more realistic information flow. After the auction bids are announced, the synergies can be deduced perfectly by the market, since α is assumed to be common knowledge.[16]

Theorem 3 (Market Reaction). If the information flow is such that the market is made aware of the possibility of a merger before the announcement ($t = 0$), then

- at $t = 0$, the first updating occurs prior to the announcement and is equal to the ex ante expected payoffs to potential bidders, $[(8\alpha^3/3) - \alpha + \frac{1}{6}]$, on average; and
- at $t = 1$, i) if there is an initiation by only 1 bidder then the average updating is $[\frac{1}{3} - (8\alpha^3/3)]$, and ii) if both bidders initiate then the average updating for the initiating bidder(s) in the strategic equilibrium is $\left[(\alpha/3) - (8\alpha^3/3)\right]$.[17]

If the information flow is such that the market is made aware of the possibility of a merger at announcement ($t = 1$), then

- at $t = 0$, there is no updating by the market; and
- at $t = 1$, i) if there is an initiation by only 1 bidder then the average updating is $[\frac{1}{2} - \alpha]$, and ii) if both bidders initiate then the average updating for the initiating bidder(s) in the strategic equilibrium is $[(-4\alpha/3) + \frac{1}{6}]$.

[16]This setup may seem artificial, as in real life $t = 1$ is typically not observed and the announcement effect is at $t = 2$. However, this is not as unrealistic as it may first appear. In equilibrium, the initiation decision is equivalent to bidders submitting an "initial bid" in the amount of 3α. This can be considered as the lower bound on their final auction bids. The intuition is as follows: In the strategic equilibrium, bidders initiate when their synergy values are greater than 2α. By initiating, they reveal their synergy values to be at least 2α, hence the minimum amount in the auction is $b_i = S_i + \alpha = 3\alpha$. Clearly, this does not allow for any strategic or preemptive bidding at $t = 1$.

[17]The updating is the expected value at $t = 1$ minus the ex ante payoffs at $t = 0$. The terminology "average" updating refers to the weighted average of the updating in different outcomes of the initiation decisions by the 2 bidders, where the weights represent the probabilities of these outcomes.

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To better illustrate, Figures 1, 2, and 3 plot these payoffs for $\alpha \in [0, ½]$. As is evident, the interplay of several issues ultimately determines the sign, magnitude, and interpretation of the market reaction. Later I discuss all in detail.

FIGURE 1

Market Reaction at $t = 0$ with Full Anticipation (strategic equilibrium)

On the *y*-axis are the ex ante expected payoffs to potential bidders in the strategic equilibrium. On the *x*-axis is the cost of losing the target to the competitor, $\alpha \in [0, ½]$.

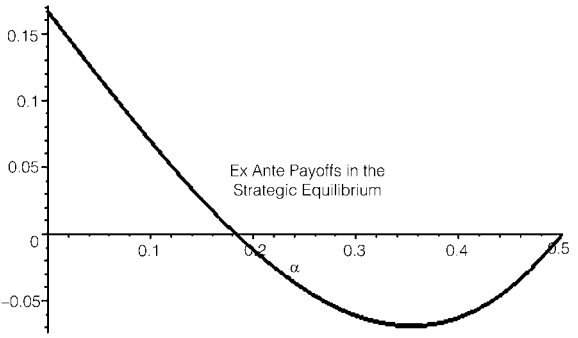
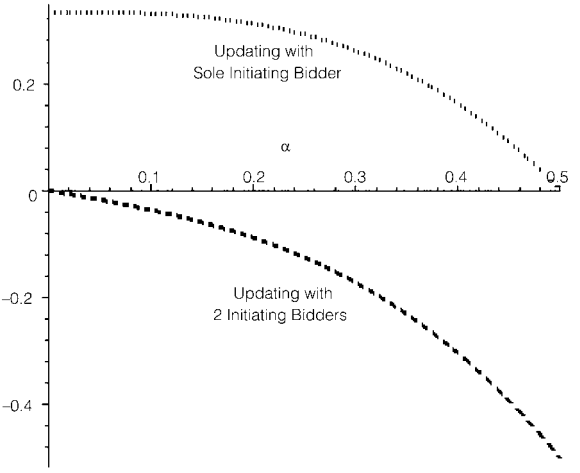


FIGURE 2

Market Reaction at $t = 1$ with Full Anticipation (strategic equilibrium)

On the *y*-axis are the expected payoffs to potential bidders in the strategic equilibrium at $t = 1$ if the market finds out about the possibility of the merger at $t = 0$ if only 1 bidder initiates (represented by the dotted line) and if 2 bidders initiate (represented by the dashed line). On the *x*-axis is the cost of losing the target to the competitor, $\alpha \in [0, ½]$.



A. Anticipation

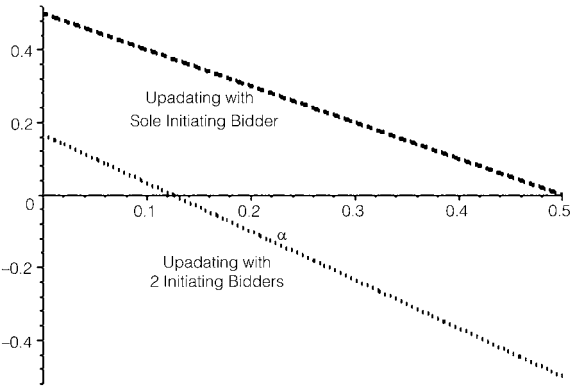
One determinant of the magnitude of the announcement reaction is the possible anticipation of the merger. Although the total bidder payoffs (sum of the

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FIGURE 3

Market Reaction at $t = 1$ with Partial Anticipation (strategic equilibrium)

On the *y*-axis are the expected payoffs to potential bidders in the strategic equilibrium at $t = 1$ if the market finds out about the possibility of the merger at $t = 1$ if only 1 bidder initiates (represented by the dashed line) and if 2 bidders initiate (represented by the dotted line). On the *x*-axis is the cost of losing the target to the competitor, $\alpha \in [0, 1/2]$.



reactions at $t = 0$ and $t = 1$) are equal in each case, the 2 information structures can lead to significant differences in what is observed at announcement ($t = 1$) and therefore in its economic interpretation. In the 2nd information structure (no anticipation), the possibility of the merger is not revealed until initiation. Then the announcement reaction reflects the full economic impact of the merger on the bidders. In contrast, the 1st information structure (full anticipation) assumes that the market anticipates the merger prior to its announcement and incorporates this information into potential bidders' stock prices at $t = 0$. At $t = 1$, investors react to the incremental information contained in the initiation decision. This can be positive or negative depending on the amount of initial updating at $t = 0$, which is equal to the ex ante expected payoffs.

As a result, even holding competition and the cost of losing constant, different levels of anticipation can produce 2 different magnitudes of announcement reaction for the bidders, which simply reaffirms the findings of the earlier studies (Malatesta and Thompson (1985), Eckbo, Maksimovic, and Williams (1990)). These studies suggest that partial anticipation is crucial in interpreting the valuation consequences of the acquisition announcements and should be controlled or accounted for if the goal is to measure the true economic impact of the mergers on bidders as well as their industry counterparts. For example, in the "full anticipation" case, interpreting the updating at announcement ($t = 1$) as the complete valuation consequence of the merger on bidders can be misleading. If there is anticipation, the correct measure, both for the acquirers and the losing rivals, is not the reaction at $t = 1$ but the *sum* of both reactions at $t = 0$ and $t = 1$.

On a larger scale, the nature of the industry shock can have similar consequences for the acquisition announcements during a wave of intense M&A activity. If an industry is expected to restructure after an easily identifiable shock, say, deregulation, and this seems necessary for the survival of the firms within the

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industry, then this anticipation is incorporated into the firms' stock prices as early as the deregulation announcement even prior to the announcement of any acquisitions in the industry. The announcement effects of acquisitions are then simply the reactions to the restructuring efforts of the firms. If instead the industry shock is not anticipated by the market, then the stock price reaction to the acquisition announcements at the early stages of the wave will also include the reaction to this new information. If one is interested in measuring the total impact of the M&A activity, perhaps the best way is to look at the sum of the initial impact experienced before the announcement of the first acquisition as well as the impact of all subsequent acquisitions that take place in the industry.

B. Competition

Another factor that is incorporated into the market reaction is the extent of competition between bidders to acquire the target's resources. Naturally, the expected payoff of a sole initiating bidder differs from that of 2 initiating bidders. When there is only 1 initiating bidder, he is guaranteed to win the auction and has a lower probability of ending up with a negative payoff. Although a sole initiating acquirer can still earn negative realized payoffs, the probability of this state is lower and therefore the average payoff remains positive. This results in an upward adjustment of the initiating bidder's value on average. When both bidders initiate, there is still uncertainty about the ultimate winner of the auction. In addition, the synergy value of the opponent is high enough to initiate a merger, hence causing the winning bidder to earn negative realized payoffs more often. In this state, even the average payoffs for the initiating bidders can be negative, causing a downward adjustment of both bidders' values at announcement.[18]

This does not suggest that the merger itself is a poor investment decision; on the contrary, it is in fact the best decision under the circumstances. Negative returns incorporate the understanding that the target is a necessary resource to survive in this changing environment; losing it to a rival is costly, and there is a positive probability that the bidder may not win or may win and pay more than its

[18] If the aggressive equilibrium is included in the analysis, a negative average reaction to all bidders initiating either as a single or competing bidders can also be supported: Let's assume that the possibility of a merger is not revealed until initiation ($t = 1$) and that the market cannot differentiate between the 2 equilibria the bidders are playing (strategic or aggressive). Also assume that the market assigns γ probability to the state in which bidders are playing the aggressive equilibrium and $1 - \gamma$ to the state in which they are playing the strategic equilibrium. Then,

- at $t = 0$, there is no updating by the market;
- at $t = 1$, for $\alpha \in [0, ½]$, the payoffs to initiating bidder(s) are on average $\Psi(\alpha, \gamma)$ where,

$$\Psi(\alpha, \gamma) \quad = \quad -\frac{4}{3}\alpha^3 + 2\alpha^2 - \alpha + \frac{1}{6} + \frac{4}{3}\gamma\alpha^3 - 2\gamma\alpha^2;$$

- furthermore, for $⅙ < \alpha < ½$, $\exists \gamma^*(\alpha) \in [0, 1]$ s.t. $\Psi(\alpha, \gamma^*(\alpha)) = 0$, and $\forall \gamma \geq \gamma^*(\alpha)$, the average announcement effect for initiating bidders is negative;
- finally, for $\alpha > ½$, the average announcement effect is $(⅙ - \alpha)$, which is always negative.

Figure 4 shows the average market reaction as a function of α and γ in this case. Proof is in the Appendix.

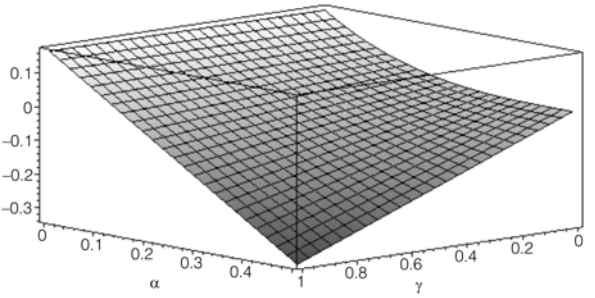
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synergy value for the target. One implication is that direct competition between 2 bidders for 1 target should exhibit the most fierce competition and the worst payoffs. It should also show negative payoffs for the losing rivals.[19] Another implication is that the competition is most fierce and the payoffs are the worst when the synergy values of the bidders are very close in magnitude.

FIGURE 4

Market Reaction at $t = 1$ with Partial Anticipation (aggressive and strategic equilibrium)

On the *z*-axis is the average market reaction to initiating bidders, $\Psi(\alpha, \gamma) = -4/3\alpha^3 + 2\alpha^2 - \alpha + 1/6 + 4/3\gamma\alpha^3 - 2\gamma\alpha^2$ if one includes both the strategic and the aggressive equilibria and the market cannot separate between the two. On the *x*-axis is the probability that the market assigns to the state in which bidders play the aggressive equilibrium, $\gamma \in [0, 1]$, and on the *y*-axis is the cost of losing the target to the competitor, $\alpha \in [0, 1/2]$.



C. Cost of Losing

Finally, the magnitude of the cost of losing determines how much a winning bidder may overpay and therefore see a downward adjustment in its stock price. The payoffs to potential bidders are affected by the magnitude of the externality (α) in 2 ways. The first is that as α increases, the equilibrium cutoff value of synergy increases $[(\partial S_c(\cdot)/\partial\alpha) > 0]$, which means that fewer mergers are initiated. The second is that a higher α leads to a higher price to be paid for the target $[(\partial b_{i,j}(\cdot)/\partial\alpha) > 0]$, which in turn causes the ex post acquirer payoffs to diminish.

Although the latter effect suggests that a higher α results in a direct negative impact on the ex post bidder payoffs, the combination of these 2 effects results in a nonlinear relationship between the negative externality and the ex ante payoffs: If α is low, the 2nd effect dominates, so an increase in α decreases the bidders' expected payoffs. If α is high, the 1st effect dominates, so an increase in α increases the bidders' expected payoffs. In the high-α region, the ex post bidder payoffs are very low but the cutoff value of synergy above which the bidders initiate is very high. Therefore, the probability of either bidder actually initiating a merger and forcing the bidders to incur these costs is much lower. However, if a merger is already initiated, a high cost of losing causes a high possible overpayment and a low market reaction at announcement.

If α represents the industry-specific factors that are common for all rivals, the magnitude of this cost of losing the target firm can be considered as a measure of industry-level competition for these resources. In other words, this can be a

[19] Some evidence consistent with this prediction is presented in the empirical implications section.

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measure for the relative scarcity of the target firm's resources by comparing the availability of substitutes for the potential bidders and the number of potential bidders themselves. A crude proxy can be the industry structure itself. For example, a concentrated industry with fewer potential targets may have a higher α than a more diverse industry with many available alternatives. Such a framework allows one to tie the heterogeneity of returns to acquirers across industries to the elements of the competitive environment within each industry instead of irrational or value-destroying motives. The effects of α also imply that high-α industries can experience long periods of waiting or "dormant" periods followed by fierce bidding wars and experience the worst payoffs.

The next section extends the competition and cost of losing aspects of the model by introducing another target that is available to multiple bidders. More specifically, it allows for Φ number of bidders and for the cost of losing to be a function of the number of available bidders. Introducing another target also allows for a direct comparison between the bids for the 1st target and the 2nd target, that is, between bidding when there still is an alternative available and bidding for the last available target.

V. Two Sequential Targets

In previous sections, there is 1 available target and when neither bidder initiates a merger then the game ends with bidders earning normalized profits of 0. Here, another potential target is introduced after the acquisition of the 1st target. More specifically, $\Phi > 2$ bidders compete for 2 potential targets that become available sequentially, as described later. Targets are assumed to be identical or substitutable in the sense that each bidder has the same synergy value for both targets. The intuition is that there may be other potential firms with similar resources that can provide the bidders with similar cost-reducing effects. This would allow the losing bidders of the 1st target to regain their competitive edge by making an acquisition of their own. To capture this opportunity, the externality is imposed on the losing bidder(s) that miss out on *both* targets.[20]

At $t = 0$, nature moves and the synergy value of each bidder for both targets (T_1 and T_2) is determined. At $t = 1$, Φ bidders make their initiation decisions for the 1st target. If at least 1 bidder initiates a merger, then there is a 2nd-price auction for the 1st target at $t = 2$, for which bidders choose their bids (b_i^1, $i = 1, \ldots, \Phi$). Since the targets are assumed to provide similar cost-reducing effect for the bidders, the incremental value of the 2nd target to the acquirer of the 1st target is 0. Therefore, the winner of the 1st auction does not participate in the 2nd auction. At $t = 3$, remaining bidders decide whether to initiate a merger for the 2nd target or not. If at least one does, then at $t = 3$ they all submit bids to compete in a 2nd-price auction for the 2nd target (b_i^2, $i = 1, \ldots, \Phi - 1$). Even

[20]The assumption that the 1st winning bidder is not penalized by the acquisition of the 2nd target by a rival is meant to offset the assumption that the winning bidder of the 1st auction does not participate in the 2nd auction. Obviously, imposing an externality on all bidders from both acquisitions would force even the winning bidder of the 1st target to participate in the 2nd auction and create richer dynamics depending on the assumed payoff structure. The goal of this section is to simply show that the existence of multiple targets will create richer dynamics.

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though the option is allowed, the outcome in which the bidders do not initiate a merger for the 1st target, wait 1 period, and initiate a merger for the 2nd target is not rational, since the identical synergy values for both targets guarantees that any positive initiation decision for the 2nd target is also optimal for the 1st target.

In both contests, the winners earn their synergy value net of the 2nd-highest bid of the corresponding auction in which they participated. The remaining $\Phi - 2$ bidders earn *industry-adjusted* externality, $[-\alpha/(\Phi - 1)]$, and the game ends. If no bidder initiates for the 1st target *and* the 2nd target, then bidders maintain the status quo and the game ends.

The industry-adjusted externality is meant to capture the potential differences in the costliness of losing a competitive edge in industries with different competitive structures. Given that α is assumed to be industry-specific, then it is reasonable to believe that the bidders' industry structure should affect how much each nonmerging rival is affected negatively. If there are only a few firms in the industry (say, a concentrated industry), then any one of them acquiring a valuable target and gaining a competitive edge can be more costly to each particular firm than if there are many firms in that industry (say, diverse). More specifically, a nonmerging firm in an industry with 20 other nonmerging rivals should be hurt less than a firm in an industry with only 3 nonmerging rivals. In effect, this assumption suggests that the full negative impact on the industry is divided among the remaining nonmerging rivals as opposed to assuming that every single one is affected by the entire amount.[21]

The analysis in this section centers around how the bidding behavior for the 1st target is affected by the opportunity to bid for the 2nd target after the 1st auction has already been initiated.[22] The effect of 2 targets on the initiation decision is straightforward. Compared to the single-target case, if another target is available for bidders with the same synergy value, the cost of losing the 1st target is lower. Therefore, they initiate more often for the 1st target. A similar effect is observed on the bids. When alternatives are available for bidders, they tend to bid less for the 1st target than they would for the last target. This result is formalized as follows.

Theorem 4. In the 2-target game with pure strategies as described previously, when an auction is initiated by at least 1 bidder for the 1st target, the bid of player i for the 1st target is

$$b_i^1 = S_i - \frac{(S_i)^{\Phi-1}}{\Phi - 1} + \frac{\alpha}{\Phi - 1},$$

and the bid for the 2nd target is

$$b_i^2 = S_i + \frac{\alpha}{\Phi - 1},$$

where $b_i^1 < b_i^2$.

[21] For $\Phi = 2$, the industry-adjusted externality is equal to α remaining consistent with the analysis of the previous section.

[22] Recent studies by Toxvaerd (2008), Rhodes-Kropf and Viswanathan (2004), Shleifer and Vishny (2003), and Morellec and Zhdanov (2005) focus on the timing of mergers and merger waves within different frameworks, although none involves a negative externality from losing the target.

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The contest for the 2nd target at $t = 2$ is simply the single-target game that is analyzed in previous sections. Hence, $b_i^2 = S_i + [\alpha/(\Phi - 1)]$, which is the value of the 2nd target for every bidder i who lost out on the 1st target. This is not the same for the bid of the 1st target. The presence of a 2nd target implies that the effective valuation of bidder i for the 1st target is not $S_i + [\alpha/(\Phi - 1)]$. The bidders who choose to enter the auction for the 1st target submit bids such that their profit from winning the 1st target is equal to their expected payoff of waiting another period for the possibility of acquiring the 2nd target. The result is a smaller bid for the 1st target than is submitted for the 2nd target ($b_i^1 < b_i^2$). The difference between the bids come from the middle term in the expression for b_i^1, which is $[-(S_i)^{\Phi-1}/(\Phi - 1)]$. The magnitude of this difference depends on the synergy value of the bidder and the number of rival bidders. The higher the synergy value of a bidder, the higher the difference between the 1st and the 2nd bids. The more rival bidders there are to compete with in the auction for the 2nd target, the smaller the difference between the 1st and 2nd bids.

The results of this section characterize the dynamics of a merger wave and present some implications as to how the bids should evolve from beginning to end. The main result of this section is intuitive; the bid for the 1st target is always less than the bid for the 2nd target. When alternatives are available for bidders, overbidding naturally subsides. The interesting implication is that one should expect to see more overbidding toward the end of a wave. In addition, it implies that the more efficient mergers, in the sense that they create the most value, occur earlier in the wave. The high cost of losing dictates that only those with the highest synergy values that translate into high winning probabilities are going to initiate mergers for the 1st target. Finally, as the number of rival bidders increases, the difference between the 1st and 2nd bids decreases.

Some recent studies provide evidence on sequential bidding in takeovers. Betton and Eckbo (2000) estimate outcome probabilities and expected payoffs associated with first, second, and final bids in a large sample of tender offer contests and provide estimates of abnormal returns to the 2nd (rival) bidder in response to the 1st bid as well as the returns at the announcement of the final contest outcome. Although they are mostly not significant in this study, a broad look at the abnormal returns for initial and rival bidders at various nodes of this "bidding tree" still paints an interesting picture. For example, at the announcement of the initial bid, rival bidders' median returns are in fact negative. Also, when a rival challenges the initial bidder, median returns to both parties are negative. Interestingly, abnormal returns that cover the announcement of the final contest outcome show that both bidders earn negative median returns regardless of who the winning party may be. The only nodes at which both bidders earn positive mean and median returns is when no bidder is successful at acquiring the target.

VI. Empirical Implications

The primary assumption of the model is the existence of a cost for the rivals of the acquirer from losing the target firm. Therefore the primary prediction is that the rivals should experience negative returns at the announcement of such acquisitions. The most straightforward empirical design can involve simply identifying

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this. Given that the story depends crucially on product-market competition and the bidders' race to acquire the target, perhaps the most direct evidence of this "cost of losing" can be found in studies of challenged bids. Looking at some earlier findings in light of this story, one can see some evidence of a negative effect for the losing bidders. For example, while examining the failed tender offers, Dodd (1980) finds negative returns not only for the successful bidders but also for the unsuccessful ones. Similarly, Bradley et al. (1983) find that when an initial bidding firm loses the target to a rival bidder, it experiences a further drop in its stock price. Recently, some of the evidence presented in Betton and Eckbo (2000) also suggests that multiple-bid contests can produce negative abnormal returns for all involved bidders.

To find empirical evidence of the "cost of losing" on a more general scale, one can condition on industrial competition and start with industry valuation estimates of horizontal mergers. However, this presents inherent challenges in that one should control for some theories that may prevent one from seeing an existing negative effect in these environments. One such theory is the market's anticipation of future acquisition prospects of the rivals. Although other studies have also shown that rivals earn positive abnormal returns on average at the announcement of horizontal acquisitions, Song and Walkling (2000) examine whether this effect is driven by the returns of the target's rivals and successfully tie this to the anticipation of their future acquisitions. They do this by showing that target rivals earn positive abnormal returns both at the announcement of horizontal and nonhorizontal acquisitions and by showing that rivals that eventually become targets earn significantly higher abnormal returns. If one is looking at returns to industry rivals as a whole during the announcement of horizontal acquisitions, the positive returns experienced by the rivals of the target may drown out any negative effect experienced by the rivals of the bidder, making it difficult to identify a possible "cost of losing."[23]

To minimize this effect, one potential approach is to follow Song and Walkling (2000) and compare returns to the acquirer's industry rivals from the horizontal and nonhorizontal acquisitions while expecting an opposite effect: According to this story, average returns to industry rivals of the acquirer should be worse in nonhorizontal acquisitions, since they would be less susceptible to the "future target" effect.[24] For a cleaner experiment, one can separate the rivals based on their future restructuring or acquisition activity as targets, acquirers, or neither. Comparisons among these subsamples can provide better insight into the rivals' fate. The expectation is that future targets should earn the highest returns, followed by future acquirers, with the worst returns to those rivals that are not making any acquisitions at all. Finally, a smaller but more refined set of rivals can also be a solution for better identifying the economic impact of these acquisitions on the acquirer's true rivals.

[23]Consistent with this intuition, Song and Walkling (2000) find that the target's industry rivals experience worse average returns (and even negative median returns) at the announcement of horizontal acquisitions where industry rivals include those of the acquirer as well.

[24]These acquisitions do not have to be pure conglomerate acquisitions in which the target and the acquiring firms are from completely unrelated industries, but nonhorizontal acquisitions where the 2 firms are from different but related industries.

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While focusing on industrial competition, it is also worthwhile to consider that different industry structures can proxy for different magnitudes of the "cost of losing," since they provide different levels of "net" competition: The extent of competition for the bidding firms will depend not only on the number of potential rival bidders but also on the number of available target firms. As shown in Section V, the scarcity of target firms as well as the homogeneity of their resources (as a good proxy for substitutes) will have an impact on the extent of the cost of losing one expects to observe in each case. For example, in a more concentrated industry there may be few potential bidders, but even fewer potential targets, translating into a higher cost of losing each target.

Another aspect of industrial competition is the prior acquisition activity in the industry. Since the portion of the cost of losing that gets paid to target firms will increase as fewer substitutes remain, later stages of a merger wave or high prior acquisition activity in the industry should translate into lower returns for both the late acquirers and the rivals. In a study of 18 industry merger waves, Floegel, Gebken, and Johanning (2005) find that returns to both bidders and their rivals decrease toward the later stages of the wave. Similarly, Akdoğu (2009) finds that in the recent telecom wave, both bidders and their competitors earn significantly worse returns during the later stages of the wave, particularly at the announcement of nonhorizontal acquisitions.

Earlier studies explicitly consider the effects of partial anticipation of the merger also on the acquirers. As shown in Section IV, anticipation does not affect the ultimate payoffs of the bidders or the rivals but the interpretation of the stock price reactions. By using frequent acquirers as an example, Malatesta and Thompson (1985) show that investors at least partially anticipate acquisition attempts and that this needs to be addressed in order to measure the true economic impact of a merger. Starting with the premise that acquirers have private information about synergies with the target, Eckbo et al. (1990) control for the truncation bias and prior anticipation by the markets. Several of their results can also be explained in light of this story. For example, they show that the higher the concentration index of the industry, the lower the bidder returns and the higher the target returns. They also find that previous mergers in the target's industry lower the returns for bidding firms.

Recently, Cai et al. (2010) show that at the announcement of an initial bid that occurs after a period of inactivity ("dormant" period), the rivals of the acquirer experience significant returns that are positively correlated with the magnitude of the acquirer abnormal returns and the length of the dormant period. They attribute this to anticipation of future acquisitions by the rivals of the acquiring firm. However, the positive correlation of acquirer and rival returns found by Cai et al. is also supportive of this theory. If acquirers earn negative returns to avoid even worse returns, then one should see rivals experiencing negative returns in such cases. This implies that when the acquirers are earning negative returns, a positive correlation between the acquirer and rival returns is also consistent with the story of this paper.[25]

[25] A negative correlation would also be consistent when the acquirers are earning positive returns, since that would imply that the rivals are getting hurt by the acquisition.

Correlation between acquirer and rival returns, particularly when acquirers are losing money, can also help differentiate this theory from several others where one expects to observe negative bidder returns but positive rival returns. Examples of such theories include stories of bidder-specific signaling, that is, when the bidder reveals overvaluation by paying with stock (Myers and Majluf (1984), Travlos (1987)) or that it is a weak competitor, since it chose merger over direct entry into a new market (McCardle and Viswanathan (1994)). These stories predict that when bidders earn negative returns, then the rivals should earn positive returns, whereas this model predicts that when bidders earn negative returns the rivals should also earn negative returns. This suggests that conditional on bidders losing money, the correlation between acquirer and rival returns can help separate this theory from others that have an opposite prediction on the acquirer's rivals.

There are other theories that can produce negative rival returns with no cost of losing. For example, Jovanovic and Braguinsky (2004) suggest that nonhorizontal acquisitions can simply be a signal that the bidder's industry lacks internal growth opportunities, hence the stock prices of both the acquirer and its rivals take a hit. Timing of the acquisition within a wave can also help one to this end. Given that the portion of the cost of losing that gets paid to target firms will increase as there are fewer remaining substitutes, this story predicts worse returns for acquirers toward the later stages of a merger wave. If a negative impact is due to information-related issues, one would expect this to be reflected in the stock prices during the earlier stages or at the very least uniformly throughout the wave.

VII. Conclusion

By interpreting mergers as an efficient reaction to an economic change where losing the target to a competitor is costly, I address several questions of the takeover literature within a rational and value-maximizing framework. First, I show that bidders are willing to systematically overpay for the targets in bidding contests. Then, I show that firms may rationally initiate mergers even when they have a negative expected payoff from initiating as long as it is less negative than the payoff of maintaining the status quo. Finally, I show that the interplay of several issues ultimately determines the sign, magnitude and interpretation of the market reaction at the announcement of a merger: the size of the loss suffered by the losing bidder, the level of competition between the bidders, and the level of anticipation of the merger by the market.

The higher the cost of losing, the less likely it is for the bidders to initiate mergers and the lower are the ex post payoffs of both the successful and the unsuccessful bidders. The higher the level of competition between the bidders or the more scarce the target, the lower the ex post payoffs of the successful bidder. Competition is most fierce and the payoffs are the worst when only 1 target is available and both bidders choose to compete. Allowing for 2 identical targets with similar resources that become available to bidders sequentially curbs this effect a bit for the 1st target. This is because the bidders are willing to pay less for the 1st target than they are for the 2nd target even though their private value for both targets is the same.

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The main contribution of this paper to the empirical studies on takeovers is its implications for the performance measures of the profitability of mergers. The merger can bring negative returns with respect to the original state; however, it will bring positive returns relative to what the firm's profits would be if the merger did not go through. Empirically, a reasonable proxy for the no-merger state might be the fate of the rivals who do not go through similar restructuring processes or make acquisitions as well as those that are not expected to be future targets. Incorporating rival returns to obtain a complete picture of the changing environment in which the acquisition decisions are made will provide meaningful answers to questions about the *relative* success of takeovers.

Appendix

Proof of Theorem 1. Following are the pure-strategy Bayesian-Nash equilibria (BNE) that survive iterated elimination of weakly dominated strategies based on the succeeding condition: If a strategy x_i does at least as well as x_i' for all strategies $x_j \in X_j$ of the opponent and better for some, then x_i weakly dominates x_i'. I show the elimination for B_i only, even though B_j eliminates the same strategies simultaneously. The 1st round of elimination involves 2 steps:

Step 1a. $x_i(S_i) = (1, b_{i1}', \min\{b_{i0}', S_i + \alpha\})$ dominates $x_i'(S_i) = (1, b_{i1}', b_{i0}')$. Let $x_j' = (0, [(b_{i0}' + S_i + \alpha)/2], 0)$.

For all strategies of the opponent where $b_{i0}' < S_i + \alpha$, playing x_i or x_i' brings player i the same outcome and the same payoff. When $b_{i0}' > S_i + \alpha$, however, playing x_i causes B_i to lose the contest and get a payoff of $-\alpha$. Playing x_i', on the other hand, causes B_i to win the contest but end up with a payoff of $S_i - [(b_{i0}' + S_i + \alpha)/2] = (S_i - \alpha - b_{i0}')/2 < -\alpha$. Similarly,

Step 1b. $x_i(S_i) = (1, \min\{b_{i1}', S_i + \alpha\}, b_{i0}')$ dominates $x_i'(S_i) = (1, b_{i1}', b_{i0}')$. Let $x_j' = (1, [(b_{i0}' + S_i + \alpha)/2], b_{j0})$.

Step 1c. $x_i(S_i) = (0, \min\{b_{i1}', S_i + \alpha\}, 0)$ dominates $x_i'(S_i) = (0, b_{i1}', 0)$. Let $x_j' = (1, b_{j1}, [(b_{i1}' + S_i + \alpha)/2])$.

This step shows that strategies involving bids that are higher than $S_i + \alpha$ are dominated.

Step 2a. $x_i(S_i) = (1, b_{i1}', \max\{b_{i0}', S_i + \alpha\})$ dominates $x_i'(S_i) = (1, b_{i1}', b_{i0}')$. Let $x_j' = (0, [(b_{i0}' + S_i + \alpha)/2], 0)$.

For all strategies of the opponent where $b_{i0}' > S_i + \alpha$, playing x_i or x_i' brings player i the same outcome and the same payoff. When $b_{i0}' < S_i + \alpha$, however, playing x_i causes B_i to win the contest and obtain a payoff of $S_i - [(b_{i0}' + S_i + \alpha)/2] = (S_i - \alpha - b_{i0}')/2$. Playing $x_i'(S_i)$, on the other hand, causes B_i to lose the contest and end up with a payoff of $-\alpha < [(S_i - \alpha - b_{i0}')/2]$. Similarly,

Step 2b. $x_i(S_i) = (1, \max\{b_{i1}', S_i + \alpha\}, b_{i0}')$ dominates $x_i'(S_i) = (1, b_{i1}', b_{i0}')$. Let $x_j' = (1, [(b_{i0}' + S_i + \alpha)/2], b_{j0})$.

Step 2c. $x_i(S_i) = (0, \max\{b_{i1}', S_i + \alpha\}, 0)$ dominates $x_i'(S_i) = (0, b_{i1}', 0)$. Let $x_j' = (1, b_{j1}, [(b_{i1}' + S_i + \alpha)/2])$.

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This step shows that strategies involving bids that are lower than $S_i + \alpha$ are dominated. Therefore, the equilibrium bids are $b_{i1} = b_{i0} \equiv b_i = S_i + \alpha$ and $b_{j1} = b_{j0} \equiv b_j = S_j + \alpha$. □

Proof of Theorem 2. To solve for the optimal initiation decision, I maximize B_i's total payoff with respect to his choice variable τ_i, given his beliefs about the opponent's strategy. The total payoff of B_i is[26]

$$\tau_i \tau_j (A_i) + \tau_i (1 - \tau_j) (A_i) + (1 - \tau_i) \tau_j (A_i),$$

which represents the 3 outcomes leading to an auction (A_i), omitting the 4th outcome $[(1 - \tau_i)(1 - \tau_j)]$, in which bidders earn normalized profits of 0. This simplifies to

$$\tau_i (1 - \tau_j) (A_i) + \tau_j (A_i),$$

where A_i is the payoff of B_i in the auction as specified in Section II.B with general bid functions. Leaving only the 1st part of the expression that is dependent on τ_i, one has

$$\text{(A-1)} \qquad \tau_i \underbrace{(\Pr(\{\tau_j = 0\}) \Pr(S_i > S_j | \{\tau_j = 0\}) \mathrm{E}_i[S_i - S_j | \{\tau_j = 0\}, S_i > S_j] - \alpha)}_{\equiv \eta_i(\tau_j(S_j); S_i, S_j)}.$$

It can easily be seen that the coefficient of τ_i, $[\equiv \eta_i(\cdot)]$, in equation (A-1) is increasing in S_i. When $\eta_i(\cdot)$ is positive, B_i will set $\tau_i = 1$, initiating a contest. For negative values of $\eta_i(\cdot)$, it will set $\tau_i = 0$. Therefore, I solve for a cutoff value of the synergy that sets the coefficient of τ_i equal to 0.

B_i's Beliefs about the Opponent's Strategy. Next, bidder *i* forms beliefs about the other bidder's strategy to determine his best response. As both players have symmetric information and similar payoffs, the opponent will similarly choose a cutoff value of synergy. Let this cutoff point be given by S_{cj}. Observing an initiation decision by B_j ($\tau_j = 1$) leads B_i to believe that the opponent's synergy value is greater than this cutoff ($S_j > S_{cj}$), and observing a noninitiation decision ($\tau_j = 0$) leads him to believe that $S_j < S_{cj}$. Incorporating his beliefs into equation (A-1),

$$\text{(A-2)} \qquad \tau_i \Pr(S_j < S_{cj}) \langle \Pr(S_j < S_i) \mathrm{E}_i[S_i - S_j | S_j < S_{cj}, S_j < S_i] - \alpha \rangle.$$

Before making a decision, B_i learns the exact magnitude of S_i, hence, whether $S_i > S_{cj}$ or $S_i < S_{cj}$. To account for this incremental information, I split S_i into 2 regions to capture these situations.

First Region ($S_i > S_{cj}$). Here,

$$\eta_i(\cdot) \quad = \quad \int_0^{S_{cj}} (S_i - S_j - \alpha) dS_j \quad = \quad S_{cj} S_i - \frac{S_{cj}^2}{2} - \alpha S_{cj},$$

where I rely on the fact that $S_i > S_{cj}$ and $S_j < S_{cj}$ imply $\Pr(S_j < S_i) = 1$.

Second Region ($S_i < S_{cj}$). Similarly, in the 2nd region, one has:

$$\eta_i(\cdot) \quad = \quad \int_0^{S_i} (S_i - S_j) dS_j - \int_0^{S_{cj}} (\alpha) dS_j \quad = \quad S_{cj} S_i - \frac{S_{cj}^2}{2} - \alpha S_{cj},$$

where I rely on the fact that $S_i < S_{cj}$ and $S_j < S_i$ imply $\Pr(S_j < S_{cj}) = 1$.

[26] For ease of exposition, the arguments of functions are dropped in the remaining expressions contained in the Appendix.

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Best-Response (Cutoff) Functions. Now, B_i picks his merger initiation cutoff by looking at the synergy value that sets the expected value of each expression equal to 0 within each region. Let this cutoff value be given by S_{ci}. For $S_i > S_{cj}$, S_{ci} is computed by setting $S_{cj}S_i - (S_{cj}^2/2) - \alpha S_{cj} = 0$. Given the opponent's cutoff, S_{cj}, B_i chooses his own cutoff value, S_{ci}, by the best-response function:

$$S_{ci} \quad = \quad \frac{S_{cj}}{2} + \alpha.$$

For $S_i < S_{cj}$, I compute S_{ci} by setting $(S_i^2/2) - \alpha S_{cj} = 0$. When his synergy value is less than the opponent's cutoff, B_i's best-response function becomes

$$S_{ci} \quad = \quad \sqrt{2\alpha S_{cj}}.$$

Due to the symmetric nature of the game, similar best-response functions apply to the other bidder. When $S_j > S_{ci}$, B_j's cutoff function is $S_{cj} = (S_{ci}/2) + \alpha$, and when $S_j < S_{ci}$, it is $S_{cj} = \sqrt{2\alpha S_{ci}}$. Let S_c be the symmetric cutoff point(s) where the cutoff functions of the 2 bidders meet. In equilibrium, 2 symmetric cutoffs are obtained: $S_c = 0$ and $S_c = 2\alpha$. □

Proof of Corollary 1. The expected value of initiating for B_i is simply his expected payoff from the auction:

$$\mathrm{E}_i[A_i] \quad = \quad \int_0^{S_i} (S_i - S_j)dS_j - \alpha \quad = \quad \frac{S_i^2}{2} - \alpha.$$

Let S_+ be the synergy value that equates the above expression to 0. Then, $S_+ = \sqrt{2\alpha}$. For $\alpha < ½$, which is the region in which mergers are initiated, $S_+ \equiv \sqrt{2\alpha} > 2\alpha \equiv S_c$.[27] Therefore, there is a region of realized synergies that fall between these cutoffs. □

Proof of Corollary 2. Follows from Theorem 2. □

Proof of Corollary 3. Given his equilibrium strategy, B_i initiates a merger as his synergy value is greater than the equilibrium cutoff ($S_i > 2\alpha$) and submits a bid of $b_i = S_i + \alpha$ in the auction. After observing that, B_j enters the auction and submits his bid, which is $b_j = S_j + \alpha$. Since $S_i > S_j$, B_i wins the contest. However, his payoff from winning is $S_i - b_j = S_i - S_j - \alpha$. As $S_j + \alpha > S_i$, the winner's realized payoff from the auction is negative. □

Proof of Theorem 3. The ex ante expected payoff to B_i in the strategic equilibrium is

$$\int_{2\alpha}^{1}\int_{0}^{S_i} (S_i - S_j - \alpha)dS_jdS_i + \int_{2\alpha}^{1}\int_{0}^{S_j} (-\alpha)dS_idS_j \quad = \quad \frac{8\alpha^3}{3} - \alpha + \frac{1}{6}.$$

The expected payoff at $t = 1$ from being the sole initiating bidder is

$$\int_{2\alpha}^{1}\int_{0}^{2\alpha} (S_i - S_j - \alpha)dS_jdS_i \quad = \quad \frac{1}{2} - \alpha.$$

The expected payoff at $t = 1$ from being 1 of the 2 initiating bidders is

$$\int_{2\alpha}^{1}\int_{2\alpha}^{S_i} (S_i - S_j - \alpha)dS_jdS_i + \int_{2\alpha}^{1}\int_{S_i}^{1} (-\alpha)dS_jdS_i \quad = \quad -\frac{4}{3}\alpha + \frac{1}{6}.$$

[27] Recall that when $\alpha > ½$, the cutoff value is greater than 1, which is the upper bound for the synergy values. Hence, no merger is initiated.

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- If the market finds out about the possibility of the merger at $t = 0$, then the updating at $t = 0$ for all bidders is exactly equal to their ex ante payoffs. The updating at $t = 1$ is equal to their corresponding expected payoffs at $t = 1$ minus their ex ante payoffs.
- If the market finds out about the possibility of the merger at $t = 1$, then the updating for bidders is equal exactly to their expected payoffs as derived previously. □

Proof of Footnote 17. The expression for $\Psi(\alpha, \gamma)$ represents the probabilities of playing the strategic equilibrium $(1 - \gamma)$, the aggressive equilibrium (γ), and their respective payoffs. Let $\Psi(\alpha, \gamma) = (1 - \gamma)\Psi_S(\alpha, \gamma) + \gamma\Psi_A(\alpha, \gamma)$, where $\Psi_S(\alpha, \gamma)$ is the total expected payoff from being one of the initiating bidders in the strategic equilibrium:

$$\begin{aligned}\Psi_S(\alpha,\gamma) &= \int_{2\alpha}^{1}\int_{0}^{S_i}(S_i - S_j - \alpha)dS_j dS_i + \int_{2\alpha}^{1}\int_{S_i}^{1}(-\alpha)dS_j dS_i \\ &= -\frac{4}{3}\alpha^3 + 2\alpha^2 - \alpha + \frac{1}{6},\end{aligned}$$

and $\Psi_A(\alpha, \gamma)$ is simply the ex ante expected payoff in the aggressive equilibrium. Putting it all together,

$$\begin{aligned}\Psi(\alpha,\gamma) &= (1-\gamma)\left\{\frac{1}{6} - \frac{4\alpha^3}{3} + 2\alpha^2 - \alpha\right\} + (\gamma)\left\{\frac{1}{6} - \alpha\right\} \\ &= -\frac{4}{3}\alpha^3 + 2\alpha^2 - \alpha + \frac{1}{6} + \frac{4}{3}\gamma\alpha^3 - 2\gamma\alpha^2.\end{aligned}$$

Let $\gamma^*(\alpha)$ be the $\gamma(\cdot)$ such that $\Psi(\alpha, \gamma^*(\alpha)) = 0$. Then,

$$\gamma^*(\alpha) = \frac{\left(8\alpha^3 - 12\alpha^2 + 6\alpha - 1\right)}{\left(8\alpha^3 - 12\alpha^2\right)}.$$

Note: $\gamma^*(⅙) = 1$ and $\gamma^*(½) = 0$ and $(\partial\gamma^*(\alpha))/\partial\alpha \leq 0$ for $\alpha \in (0, ⅜]$. □

Proof of Theorem 4. The 1st auction, A_{i1}, brings B_i the following payoff:[28]

$$A_{i1} = I\{b_i^1 = \max\{b_j^1\}_{j=1}^{\Phi}\}(S_i - \max\{b_j^1\}_{j\neq i}^{\Phi}) + I\{b_i^1 \neq \max\{b_j^1\}_{j=1}^{\Phi}\}(A_{i2}),$$

where A_{i2} is the auction for the 2nd target and $I\{\cdot\}$, the indicator function. Then, A_{i2} is

$$\begin{aligned}A_{i2} &= I\{b_i^2 = \max\{b_j^2\}_{j=1}^{\Phi-1}\}(S_i - \max\{b_j^2\}_{j\neq i}^{\Phi-1}) \\ &\quad + I\{b_i^2 \neq \max\{b_j^2\}_{j=1}^{\Phi-1}\}\left(\frac{-\alpha}{\Phi - 1}\right).\end{aligned}$$

The bidding strategy in the auction for the last target is equivalent to that of the single-target game that is analyzed in the previous section, $b_i^2 = S_i + [\alpha/(\Phi - 1)]$.

[28] Note that, in this section, $b_i^1 = b_i^1(\tau_{-i}\,;\, S_i)$, where $\tau_{-i} = \{\tau_j\}_{j\neq i}^{\Phi}$ and $b_i^2 = b_i^2(\tau_{-i}\,;\, S_i)$, where $\tau_{-i} = \{\tau_j\}_{j\neq i}^{\Phi-1}$. To be consistent with the strategy specification of the previous section, for all $2^{\Phi-1}$ different combinations of the initiation decisions of the Φ opponents, one should specify different bids for player i; b_{ik}^1 where $k = 1$ to $2^{(\Phi-1)}$. As all $2^{(\Phi-1)}$ bid combinations are equal in equilibrium, one chooses not to complicate the terminology any further.

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The expected payoff of waiting for another period, $\mathrm{E}_i(A_{i2})$, is calculated as follows: Let S_k be the value of the 2nd-highest bidder for the 2nd target. Then,

$$\begin{aligned}\mathrm{E}\left[S_k|S_k=\max\{S_j\}_{j\neq i}^{\Phi-1}, S_k<S_i\right] &= S_i-\frac{1}{(S_i)^{\Phi-2}}\left[\frac{(x)^{\Phi-1}}{\Phi-1}\right]_0^{S_i}\\ &= S_i-\frac{S_i}{\Phi-1}.\end{aligned}$$

This gives

$$\begin{aligned}\mathrm{E}_i(A_{i2}) &= \Pr(S_i=\max\{S_j\}_{j=1}^{\Phi-1})[S_i-\mathrm{E}(S_k|\cdot)]-\left(\frac{\alpha}{\Phi-1}\right)\\ &= (S_i)^{\Phi-2}\left(\frac{S_i}{\Phi-1}\right)-\frac{\alpha}{\Phi-1} = \frac{(S_i)^{\Phi-1}}{\Phi-1}-\frac{\alpha}{\Phi-1}.\end{aligned}$$

Incorporating this result into player i's payoff in the 1st auction, A_{i1},

$$\begin{aligned}A_{i1} &= I\{b_i^1=\max\{b_j^1\}_{j=1}^{\Phi}\}(S_i-\max\{b_j^1\}_{j\neq i}^{\Phi})+I\{b_i^1\neq\max\{b_j^1\}_{j=1}^{\Phi}\}\\ &\quad\times\left(\frac{(S_i)^{\Phi-1}}{\Phi-1}-\frac{\alpha}{\Phi-1}\right).\end{aligned}$$

The value of the 1st target to B_i becomes: $S_i-[(S_i)^{\Phi-1}/(\Phi-1)]+[\alpha/(\Phi-1)]$. In a 2nd-price auction, bidding your true valuation dominates bidding any amount higher or lower.[29] As a result, the bid for the 1st target is

$$b_i^1 = S_i-\frac{(S_i)^{\Phi-1}}{\Phi-1}+\frac{\alpha}{\Phi-1}.$$

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[29]The proof is similar to that of Theorem 1.

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