Toeholds, Bid-Jumps and Expected Payoffs in Takeovers[1]

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November 1999
Forthcoming, *Review of Financial Studies*

[1]Earlier drafts of this paper were entitled "State-Contingent Payoffs in Takeovers: New Structural Estimates" (Betton and Eckbo (1997)). We are grateful for the comments and suggestions of Jonathan Berk, Larry Dann, Wayne Ferson, Robert Hansen, Robert Harris, Cliff Holderness, Burton Hollifield, Robert Jennings, Charles Kahn, Paul Malatesta, Øyvind Norli, Enrico Perotti, Jay Ritter, David Smith, Barbara Spencer, Matthew Spiegel, Rene Stulz, Sheridan Titman (the editor), Theo Vermaelen, Joseph Williams, Robert White, an anonymous referee, and seminar participants at Boston College, Boston University, Dartmouth College, Gothenburg University, INSEAD, the Norwegian School of Economics, Norwegian School of Management, Securities and Exchange Commission, Simon Fraser University, Stockholm School of Economics, Southern Methodist University, University of Aarhus, University of Amsterdam, University of British Columbia, University of Illinois at Urbana-Champaign, University of Florida at Gainesville, University of California at Riverside, University of Southern California, University of Vienna, University of Washington, University of Toronto, and the meetings of the European Finance Association, the American Finance Association, the Nordic Symposium on Corporate and Institutional Finance (Oslo), the Utah Winter Finance Conference, and the Lisabon Conference on Corporate Finance of the Center for Economic Policy Research (CEPR, London). Address correspondance to: B. Espen Eckbo, Tuck School at Dartmouth, Hanover, NH 03755, USA. The authors' email addresses are b.espen.eckbo@dartmouth.edu and betton@vax2.concordia.ca.

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Abstract

We estimate sequentially outcome-probabilities and expected payoffs associated with first-, second- and final bids in a large sample of tender offer contests. Rival bids arrive quickly and produce large bid-jumps. Greater bidder toeholds (pre-bid ownership of target shares) reduce the probability of competition and target resistance and are associated with both lower bid-premiums and lower pre-bid target stock-price runups. The expected payoff to target shareholders is increasing in the bid-premium and in the probability of competition, but decreasing in the bidder's toehold. The initial bidder's expected payoff is significantly positive in the "rival-bidder-win" outcome, in part reflecting gains from the pending toehold-sale. Despite these dramatic toehold effects, only half of the initial bidders acquire toeholds.

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There is substantial theoretical support for the notion that the size of the bidder's toehold (pre-offer ownership stake in the target) plays an important role in the formulation of optimal bidding strategies. In Shleifer and Vishny (1986), Hirshleifer and Titman (1990), and Chowdry and Jegadeesh (1994), a toehold helps overcome the free-rider problem among target shareholders described by Grossman and Hart (1980). Owning a toehold gives a bidder a profit from a successful takeover, even if it has to pay the expected full value for any shares bought in the tender offer.[1] In Burkart (1995), Singh (1998) and Bulow, Huang and Klemperer (1999), the dual nature of the offer price as a bid for the remaining shares and an ask for the toehold leads to aggressive bidding behavior.[2] Intuitively, the toehold reduces the number of target shares that must be purchased at a costly premium, and it provides a capital gain should a rival bidder win the contest and purchase the toehold.

Despite the substantial theoretical interest in toeholds, available empirical evidence on the impact of toeholds on takeover bids is sparse. Examining block purchases that exceed 5% and therefore trigger 13d disclosures with the Securities and Exchange Commission (SEC), the evidence in Mikkelson and Ruback (1985), Choi (1991), and Barclay and Holderness (1991) suggests that stock price runups observed prior to takeover bid announcements are in part driven by these early toehold acquisitions. Bradley, Desai and Kim (1988) report average toeholds of 10% at the time of the takeover bid, and Jennings and Mazzeo (1993) report that toeholds decrease the probability of target management resistance. There is little evidence on the effect of toeholds on bidder returns, and the evidence on target returns is ambiguous: Target returns are found to either decrease with toeholds (Jarrell and Poulsen (1989) and Eckbo and Langohr (1989)), increase (Franks and Harris (1989)), or have no effect (Stulz, Walkling and Song (1990)).

This paper provides evidence on the size and impact of premiums and toeholds on outcome-

[1] In these models, all of a bidder's profit are accounted for by gains on its toehold. In the Shleifer-Vishny and Hirshleifer-Titman models, increasing the toehold reduces the successful bid price, while it increases the successful offer price in the Chowdry-Jegadeesh model. The empirical analysis below addresses these predictions.

[2] In the Bulow-Huang-Klemperer model with common value bidders, such aggressiveness increases the winner's curse for a nontoeholder and makes *its* bid more conservative in an ascending auction. This in turn reduces the toeholder's winner's curse and allows it to be more aggressive still, creating a potentially powerful feedback loop. "So owning a toehold can help the bidder win an auction, and win cheaply" (p.428). These models also imply that bidders sometimes rationally "overpay" for the targets ex post, without appealing to managerial hubris or agency problems. See also Chowdry and Nanda (1993) in the context of debt-financed bidding.

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probabilities and expected payoffs using a comprehensive sample of 2,335 takeover bids taking place in 1,353 tender offer contests, 1971-1990. Our main contribution is threefold: First, we structure the empirical analysis around *entire tender offer contests* so that it closely replicates the actual bidding environment. Existing studies of tender offers tend to offer systematic information on final—but not on initial—bids and thus are not as well suited to examine bidding arguments.[3] We provide descriptive information on the speed of arrival of rival bids, the size of the bid jumps, and on the duration and final outcome of the entire auction. We show that rival bids arrive quickly, typically within 15 days,[4] and generate substantial bid-jumps: between the first and the second bid, the premium increases on average 31%.

Second, our empirical analysis explicitly accounts for the joint impact of four key offer characteristics: The offer premium, the toehold, target shareholder tender precommitments (which incases the bidder's *effective* toehold), as well as the payment method (cash versus stock). Several models suggests that these offer parameters are important in the takeover process. For example, in Giammarino and Heinkel (1986), Fishman (1988) and Hirshleifer and Png (1989), a high initial bid premium signals a high bidder valuation which deters competition in an environment where bidding is costly. In Fishman (1989), the choice of payment method also affects competition as the unconditional nature (with respect to the true target value) of a cash payment can be used a signal by high-valuation bidders. Focusing on single-bidder environments, Hansen (1987), Eckbo, Giammarino and Heinkel (1990), Berkovitch and Narayanan (1990), and Brown and Ryngaert (1992) also stress the signaling benefit of cash as payment method. However, structural tests of the signaling argument has so far failed to provide much empirical support (Eckbo, Giammarino, and Heinkel (1990)).

We find that toeholds are largest in successful, single-bid contests (average 20%) and smallest in multiple-bid contests (average 5%). Simultaneous-equation estimation indicates that toeholds and offer premiums are negatively correlated, which is consistent with the comparative statics results

[3]For example, Bradley, Desai and Kim (1988) sample successful (and thus *final*) bids only, thus ignoring information on earlier bids in multiple-bid contests. Similarly, although Jennings and Mazzeo (1993) and Schwert (1996) sample unsuccessful as well as successful bids, they do not identify the bid-sequence in multiple-bid contests.

[4]Under the Williams Act, the initial tender offer must be outstanding at least 20 days.

of Shleifer and Vishny (1986) and Hirshleifer and Titman (1990), but fails to support the signaling argument of Chowdry and Jegadeesh (1994). Moreover, we find that toeholds are smaller the greater the pre-bid runup in the target's share price, which fails to support the model of Ravid and Spiegel (1999).[5] Interestingly, when the initial bid fails to deter competition, the first and the second bidder turn out to own similar toeholds, a possibility that is addressed by the model in Bulow, Huang and Klemperer (1999).

The model of Bulow, Huang and Klemperer (1999) also implies that if two or more bidders have toeholds, offer prices will be highest if all bidders have toeholds of similar size. Thus, it may pay the target firm to "level the playing field" by giving a rival bidder the opportunity to buy a toehold cheaply. Our evidence shows that the target enters into a share tender agreements with the initial bidder—which is one way for the target to equalize effective toeholds in anticipation of rival bids—in 23% of the cases. However, these initial bids attract competition (or are revised) at a much lower rate than the typical initial bid. Thus, we cannot conclude that these share tender agreements are designed to increase competition among rival bidders. Overall, while there appears to be significant benefits for the initial bidder to acquire a toehold, a puzzling 47% of all initial bidders in the sample enter the contest with a zero toehold.[6]

Third, a major objective of this paper perform a sequential, forward-looking estimation of offer outcome-probabilities and expected payoffs as a function of offer characteristics. This analysis requires a structure outlining the most relevant outcomes facing *any* initial bidder and, for this purpose, we use the contest tree shown in Figure 1. The tree structure in Figure 1 exploits the large data set as each of the 11 outcomes (nodes) in the tree contains a substantial number of sample bids (shown in parentheses). If the market uses the same tree structure to price the bid, then the stock price reaction to the bid announcement equals the product of the probabilities and payoffs summed across all the nodes in the tree. We use this assumption to estimate the payoffs

[5] A toehold purchase that creates rumors of a pending takeover bid results in a runup in the target share price. In Ravid and Spiegel (1999), this runup increases the total cost (premium) of the takeover because the legally permissible amount of dilution in a minority freeze-out merger is constrained by the preoffer price.

[6] In their sample of 236 successful tender offers, Bradley, Desai and Kim (1988) also report that a substantial proportion (66%) of the bidders have zero toeholds. Some evidence of infrequent toehold acquisitions is also presented by Bris (1999).

at each individual node as parameters in cross-sectional regressions of announcement-returns on outcome-probabilities. These parameter estimates in turn allow us to compute the expected value of the offer conditional on a given offer configuration (bid premium, toehold, payment method, etc.).

We find that, at the time of the initial bid, the probability of a successful single-bid contest increases with the size of the offer premium, the toehold, with the presence of a pre-bid tender agreement. Interestingly, following the entry of a rival bidder, *none* of these offer parameters are significant predictors of which bidder (if any) will eventually win the contest. Thus, it appears that the "strategic" effect of key offer characteristics such as the bid premium and toehold is limited to the initial bid. Contrary to the finding of Jennings and Mazzeo (1993) and others, the payment method is not found to be a significant determinant of the outcome-probabilities anywhere in the contest tree. It appears that the marginal impact of the payment method is swamped by toehold effects.

We also find that the payoff to target shareholders increases with the probability of a successful contest, with the probability of multiple bids, and with the probability that a rival bidder eventually wins the contest. Our results generalize to an *ex ante* framework the well-known finding in the literature that target gains are on average greater in multiple-bid contests than in single-bid contests (e.g., Bradley, Desai and Kim (1988)). However, we also show that the toehold size plays a fundamental role in producing this effect. Ex ante, target gains decrease with the size of the initial bidder's toehold because the greater the toehold, the greater the probability of the relatively low-target-payoff single-bid-success outcome.

As to bidder firms, there is no evidence that the expected value of the initial bid is significantly diferent from zero. This is consistent with the generally insignificant *ex post* average abnormal returns to bidders reported in the literature.[7] However, again this conclusion appears to depend on the initial toehold: The initial bidder's payoff is found to be significantly positive in the "rival-bidder-wins" outcome of the contest tree. Since there is no evidence of significantly negative initial

[7]See Eckbo and Thorburn (1999) for a review of the literature and large-sample evidence of significantly positive average bidder gains in domestic acquisitions in Canada.

bidder payoff in any of the successful outcomes, nor is there evidence of a positive bidder payoff when the target rejects *all* bids, there is no direct evidence of "overbidding". A consistent interpretation of the positive payoff associated with the "rival-bidder-wins" outcome is that it reflects expected gains from selling the initial toehold to the successful rival bidder.

The rest of the paper is organized as follows. Section 1 details our contest event tree structure and the sample selection procedures. Section 2 describes the basic characteristics of the tender offer contests in terms of duration, time between successive bids, average offer premiums and toeholds. Section 3 details the structural estimation of the contest tree in Figure 1, while Section 4 concludes the paper.

1 Sample selection and contest characteristics

1.1 Sample of tender offer contests

To make a tender offer, the bidder must file a 14d statement with the SEC, which form our initial sample source. We identified a total of 2001 14d filings from January 1971 to December 1990, using the following three sources: (1) The *Austin* data base, which includes 14d filings from January 1971 to December 1986. Filings which indicated a transaction value of less than $1 million or initial holdings of greater than 90% were excluded, resulting in 1643 filings. (2) The *Simon* data base, obtained from the Dialog Electronic service (File #548, M & A Filings), which contains 14d filings for the period from January 1986 to December 1990. In order to be included, the filings had to have an indicated value of at least $1 million and be for at least 5% of the target shares, resulting in 261 filings. (3) *The Mergerstat Review*, which supplements the Simon data for 1987 to 1990 with an additional 97 filings.

For a given 14d filing, bids in the same *takeover contest* are identified by searching The Wall Street Journal (WSJ) for bids or "continuation events" during the 3 calendar months before or after the tender offer announcement date. A continuation event is defined as any event that indicates that the contest is continuing, e.g., due to additional bids, announcements that the target and bidder are negotiating, lawsuits are occuring, targets are searching for new bidders, etc.. Announcement dates and contest beginning dates are taken from the WSJI. The WSJI information on ending dates is supplemented with information from the University of Chicago Center for Research in Security Prices (CRSP) tapes and the Commerce Clearing House (CCH) Corporate Capital Structure Changes Reporter. The 7-month search procedure is repeated for each identified bid or continuation event, and the starting and ending dates are given by the earliest and latest dates in the group of identified bids.[8] Note that this procedure identifies *all* bids for the target during the moving 7-month window, including unsuccessful initial merger bids that were followed by a 14d tender offer, tender offers that were withdrawn within five days and which according to SEC rules do not require a 14d filing, and any merger bid following an initial 14d tender offer.

Of the 2001 14d filings, 627 are excluded from the sample due to missing WSJI information on tender offer announcement dates and beginning and ending dates of the tender offer contests. Finally, another 21 contests are excluded because the initial bidder held more than 80% of the target prior to the offer. Sample firms which announced supermajority charter provisions during the sample period all required 80% shareholder support in order for a bidder to force a merger. Thus the 80% screen eliminates from the sample all minority buyouts in firms with supermajority provisions. The 80% screen also rules out tax free stock swaps. The final sample consists of 1353 tender offer contests over the period 1971-1990. The 1353 contests represent 2335 bids for 1271 different targets. Sixty-four percent of all bids, and 87% of all initial bids, are represented by 14d filings.

1.2 Contest design and characteristics

Figure 1 shows the distribution of the final sample across the ten potential outcomes in the contest tree following the initial bid. The tree includes only the most central events in a typical contest, and we focus in particular on the *initial* and *second* bids (as it turns out, the configuration of subsequent bids do not materially affect the final outcome probabilities). Moreover, for the purpose

[8]If information on the ending date is missing from the WSJI, we use the maximum of the latest announcement date and the latest identified ending date in the group of bids to define the duration of the contest. To the extent that this procedure also fails to produce an ending date, we consult the CRSP tape (for delisting dates) and the CCH Corporate Capital Structure Changes Reporter. The above procedure produces ending dates for all but 38 contests in the sample. For these 38 contests, the ending date is estimated as the median length of other contests occurring in the same year.

of the subsequent event study, we require each node in the tree to be identifiable in terms of a calendar date. As a result, there is no separate node for "target resistance", as signs of resistance typically emerge gradually between the initial and second bid. Instead, direct information on target management resistance is used as a determinant of the outcome-probabilities conditional on a second bid in the contest (when the degree of resistance is typically known).

The contest tree in Figure 1 has three distinct stages. Stage 1 (node $n = 0$) reveals the initial bid ($\mathbf{x}$). This bid results in one of four possible events (Stage 2):

- The contest ends with only one bid having been made. The initial bidder is either unsuccessful (node $n = 1$) or successful (node $n = 2$).
- A second bid is made in the contest, either by the initial bidder (node $n = 3$) or by a rival bidder (node $n = 4$).

Thus, at Stage 2, a decision is made whether or not to revise the initial bid, or for rival bidders to enter the contest. This decision in turn implies observed changes in the values of the offer parameter vector $\mathbf{x}$. Finally, Stage 3 reveals the outcome of multiple-bid contests, which may follow a number of rival bids and counterbids. The initial bidder wins (nodes $n = 5$ and $n = 8$), a rival bidder wins (nodes $n = 6$ and $n = 9$), or no bidder succeeds in acquiring the target (nodes $n = 7$ and $n = 10$).

The annual number of contests across each of the final outcome nodes ($n = 1, 2, 5, .., 10$) is shown in Table 1 (for clarity, we are preserving the tree structure –in terms of stages and nodes– in several of our tables throughout the paper). Based on the target's major 4-digit Standard Industrial Classification (SIC) codes for the year prior to the offer, about half of the contests are in manufacturing industries, and another ten percent in the financial industry. The distribution of the number of multiple-bidder contests across industries and across time is similar to the distribution for single-bidder contests, again with the bulk of the offers occurring in manufacturing industries.

Of the 1,353 contests, 62% are single-bid. The solid line in Figure 2 shows the frequency distribution of the duration of these single-bid contests (days from initial bid to final outcome). The average duration is 40 days with a median of 29. The 80-percentile is 52 days and the 90-percentile is 73 days. Figure 2 also shows the frequency of the duration of multiple-bid contests from the first to the second bid, and from the initial bid to the final contest outcome. Looking first at the total contest duration, the average (median) is 70 (51) days, and 80 percent of the multiple-bid contests lasts less than 98 days. The 90-percentile is 142 days, and a handful of cases lasts more than 200 days, primarily due to court-challenges and various delay tactics instituted by target management (the sample maximum is 443 days).

When a contest develops multiple bids, the second bid on average arrives after 14.5 days, with a median of 14. Moreover, in Figure 2, the 80th-percentile for the time to the second bid is 40 days. In general, the expected time to arrival of a second bid depends on the cost to rival bidders of becoming informed of their own valuation of the target, as well as the time it takes to file a formal offer. Unless the initial bid was largely anticipated by the rival bidders, a median of 14 days appears "short" unless the source of the target value is relatively easily established (e.g., eliminating inefficient management, free cash flow, reduce bankruptcy costs, etc.). In other words, the nature of the source of expected takeover gains is a likely determinant of the expected time to the second bid.

We classify target management reaction to bids based on information in the WSJI and the 14d filings. The target management response is categorized as supportive, neutral, or opposed, as follows: (1) *Supportive:* Target management states that the offer is fair, equitable, or that the bid is friendly. Alternatively, it is announced that the bidder has agreed to acquire the target, possibly following negotiations with target management. (2) *Neutral*: No management reaction is reported in the WSJI, or the report is neutral. (3) *Opposed*: Target management states that the offer is unfair; fraudulent; inadequate; unfriendly; that it is suing or otherwise intending to fight the takeover; or that it has received or been denied an injunction against the bidder. With these definitions, target management opposes the initial bid in 30% of the total sample. The proportion of bids that elicits target management opposition is significantly higher in multiple-bid than in single-bid contests: 54% versus 14%. Thus, a contest develops multiple bids in part to fend off a negative target management reaction to the initial bid.

Of the multiple-bid contests, 41% have only one bidder, where the initial bidder revises the initial bid. In these cases, the bidder raises the initial offer although a rival bidder is never observed to enter the contest. Such bid revisions are first observed in the sample year 1974, and approximately 40% of the cases occur in the three-year period 1986 through 1988. These bid revisions could be induced by *rumors* that a second bidder might launch a competing bid. However, a search of the WSJI for reports of such rumors reveals rumors in 5% of the single-bid contests and in only 6% of the multiple-bid, single bidder contests. These two frequencies are both low and insignificantly different from each other.[9] Thus, we cannot conclude that rumored competition is an important explanation for bid revisions in what turns out to be single-bidder contests. It is also possible that these bid revisions occur in response to rumors that the target board intend to decline the initial bid, or will give a hostile response. We do not, however, have any empirical evidence to support this explanation.

The overall (unconditional) success rate of the bids is 79%, with successful bidders acquiring an average of 80% of the target shares.[10] The average number of bids per contest is 2.5 when the initial bidder is successful, and 3.9 when a rival bidder succeeds, and the maximum number of bids is 12. The corresponding average number of bidders is 1.1 and 2.3, with a maximum of 5.

We now turn to descriptive information on toeholds and offer premiums, and we perform regression analyses indicating the major determinants of these two offer parameters within single-bid and multiple-bid contests.

[9]The significance is tested using a standard Z test for comparing the proportions of two independent samples:

$$Z = \frac{\hat{p_1} - \hat{p_2}}{\sqrt{\hat{p}(1-\hat{p})(1/N_1 + 1/N_2)}}$$

where Z is a standard normal. Sample i has N_i observations and the proportion of interest is denoted p_i. The overall proportion (in the combined sample) is denoted by $\hat{p}$.

[10]Our definition of success requires purchase of a minimum of 5% of the target shares. However, the frequency distribution of acquired shares is heavily skewed to the right, with almost every successful bidder acquiring 50% or more of the target. Moreover, for any given contest, our definition of success leads to multiple successful bidders in six cases only. Bidder share holdings following the contest are collected from the WSJI and company filings. If the acquisition is described by the WSJI as "done", "completed", or "successful", and there is no specific information available from the filing, then the bidder is assumed to have acquired the desired number of shares (typically 100% of the target).

2 Toeholds, premiums and bid-jumps

Table 2 lists the offer premiums of the first and final bids, classified by the type of contest and the target management response. If p_o denotes the offer price per share, the offer premium is calculated as $(p_o - p_{-60})/p_{-60}$, where p_{-60} is the target share price (corrected for dividends and stock splits) 60 days prior to the offer date. As illustrated in Figure 3 (the estimation procedure behind Figure 3 is described below), the price on day -60 shows little evidence of anticipating the subsequent takeover bid, and is therefore a reasonable representation of a non-informative base price for offer premium calculations. In comparison, Bradley (1980) use day -40, while Schwert (1996) identifies day -42, as the pre-anticipation day.

In single-bid contests, the initial (and final) offer premium averages 51%. The average premium is substantially lower in single-bid contests opposed by target management than in contests not opposed by management (39% v 60% in offers receiving target management support). This suggests that one reason for target management resistance is a low initial bid. In multiple-bid contests, the average offer premium increases from 45% in the initial bid to 74% in the final bid. Again, target management tends to oppose initial offers with a relatively low premium, on average driving the final offer premium to 84%.

If single-bid and multiple-bidder tender offer contests are drawn from the same distribution, and if single-bid contests are the result of preemptive bidding as suggested by the theory in Fishman (1988), then one would expect the offer premium in single-bid contests to exceed the *initial* offer premium in multiple-bid contests. This proposition receives some support in Table 2 since the average initial offer premium in single-bidder contests is 51%, compared to the average initial offer premium of 45% in multiple-bid contests. Looking beyond the "all contest" category, it is seen that the support for the pre-emptive bidding argument is limited to the sample of offers that did not generate target management opposition. Thus, a relatively high initial offer premium appears to preempt target management opposition as well as rival bids.

Table 3 shows the median values of the bid-jump between the first and second bids, between the second and final bids, and of the average jump per bid in the contest. The table shows bid-jumps in terms of percent change in the initial bid *price* as well as the percent change in the initial bid *premium*. As shown in Panel I, the median increase in the bid price from the first to the second offer is 10.0%, which corresponds to a median increase in the initial offer premium of 31%. Moreover, the median values of the average bid-price and bid premium jumps across all bids in the contest equal 5.3% and 16.7% respectively. Thus, the greatest bid-jumps typically occur between the first and second bids in the contest. Moreover, Panel II and III show that the bid-jumps are generally lower when the second bid in the contest is made by the initial bidder. The second bid in the contest typically jump by 13.9% over the first bid (corresponding to a 45.2% premium increase) when a rival bidder enters and make the second bid. This bid-jump evidence is consistent with the presence of significant bidding costs as well as private bidder values in these auctions.

Table 4 lists average bidder toeholds classified by type of contest and the target management response. Toehold information is required in 14d filings, and we merge the 14d information with information in the WSJI, the Mergerstat Review and the MERC database. The initial bidder toehold is zero in 46% of the sample, and less than 10% in 64% of the contests. Substantial toeholds are also present in the sample; in 36% of the sample, the toehold is greater than or equal to 10%, and in 11% of the cases the bidder's initial toehold exceeds 50% of the target shares.

The initial bidder's toehold is on average greater in single-bid contests (19%), and greater in multiple-bid contests with a single bidder than with multiple bidders (11% vs. 5%). In multiple-bid contests, very few toeholds exceed 20%. While not shown in Table 4, there is also an association between size of the toehold and the order of the bids in the contest. For the overall sample, the average toehold of the first bidder is 14%, which contrasts with average toeholds of subsequent rival bidders of between 5% and 8%. The initial bidder in multiple-bidder contests holds, on average, less than 5% of the target at the start of the contest. Furthermore, rival bidders enter such contests with approximately the same toehold as the initial bidder.

Prior to the initial bid, the bidder negotiated a tender-agreement with target management and/or a major target blockholder in a total of 311 cases (23% of the sample). Of these, only 47 cases (14.6%) developed into multiple-bid contests, and only one case (.40%) was opposed by target management. While we do not have data on the exact magnitude of the size of the tender precommitments specified in these agreements, the agreements effectively increase the size of the bidder's initial toehold. As shown below, there is strong evidence that the presence of a negotiated tender-agreement increases the initial bidder's chance of single-bid success.

Tables 5 and 6 shows the results of regressing the initial bidder's toehold on various contest characteristics. Table 5 presents a single-equation estimation while Table 6 shows the parameters in a two-equation system where the toehold and the offer premium are determined simultaneously. The regression equation in Table 5 is as follows:

$$\begin{aligned} Toehold &= \alpha_0 + \alpha_1 Runup + \alpha_2 Premium + \alpha_3 Hostile + \alpha_4 Iwin + \alpha_5 Rwin + \\ &\quad + \alpha_6 Irevise + \alpha_7 Onebid + \epsilon, \end{aligned} \tag{1}$$

where *Runup* is the target cumulative abnormal stock return over days -60 through -1 relative to initial bid announcement, and *Premium* is the initial offer premium (relative to day -60). The remaining six regressors are zero-one binary variables: *Hostile* equals one if the target management opposes the initial bid, *Iwin* equals one if the initial bidder wins the contest, *Rwin* equals one if a rival wins the contest, *Irevise* equals one for single-bidder, multiple-bid contests, *Onebid* equals one for single-bidder contests, and ϵ is a mean zero error term.

The results in Table 5 are significant whether one uses OLS or a truncated Tobit regression.[11] Toeholds are *lower* the greater the pre-contest target runup, which fails to support the model of Ravid and Spiegel (1999) where *Runup* is modeled as a result of toehold purchases.[12] The significantly positive coefficients for *Iwin* and *Onebid* strongly confirms the earlier finding in Table 4 that toeholds are higher in single-bid successful contests. Similarly, the significantly negative coefficients of *Hostile* and *Irevise* confirms that toeholds are significantly lower in contests where the initial bid develops competition, either from rival bidders or (hostile) target management.

The regressions in Table 5 fails to indicate a significant relationship between the toehold and the

[11] The truncated Tobit regression (see, e.g., Maddala (1983)) is motivated by the fact that the observed toehold may differ from the bidder's actual toehold position, in part due to a potential short position in the target and in part because of our 80% upper limit on toeholds.

[12] We also checked a two-equation setup for the simultaneous determination of the toehold and the runup. The conclusion in the text remains unaffected.

offer premium. Given the potentially joint nature of the toehold-premium decision, Table 6 shows the results of three-stage least squares estimation of two simultaneous equations for the toehold (first equation) and the initial offer premium (second equation):

$$\begin{aligned} Toehold &= \beta_0 + \beta_1 Runup + \beta_3 Multibid + \beta_4 Hostile + \beta_5 lnTsize \\ Premium &= \gamma_0 + \gamma_2 Markup + \gamma_3 Multibid + \gamma_4 Hostile + \gamma_6 Toehold + \gamma_7 ZeroToe, \end{aligned} \tag{2}$$

where *Markup* is the abnormal target stock return over the s-day period ending with the bid announcement day, *Multibid* is a binary variable for multiple bids, *lnTsize* is the logarithm of the total equity size of the target, and *ZeroToe* is a binary variable for zero toeholds. Again, the first equation confirms that toeholds are significantly lower for hostile bids and when the initial bids attracts rival bidder entry. The initial offer premium (second equation) is increasing in *Markup*, decreasing in the target equity size and, as discussed earlier, is lower for resisted offers. Interestingly, the premium is also significantly lower the greater the toehold. The latter result is consistent with the models of Shleifer and Vishny (1986) and Hirshleifer and Titman (1990) but fails to support the signaling argument of Chowdry and Jegadeesh (1994).

While the results in Table 5 and 6 are interesting, they do not indicate the marginal impact of the offer characteristics on either the outcome-probabilities nor on the expected value of the bid. For example, while Table 6 shows that there is a negative tradeoff between the toehold and the offer premium, an even more interesting question is how the offer parameters jointly determine the value and outcome of the bid. To answer this question, we now turn to a structural, forward-looking analysis that closely replicates the actual bidding environment.

3 Conditional expected value of bid: Structural estimation

In this section, we use the contest tree structure depicted in Figure 1 to estimate the impact of the vector of offer characteristics, $\mathbf{x}$, on the vector of outcome-probabilities, $\mathbf{p(x)}$, and the vector of payoffs at each node of the tree, μ. As stated in the introduction, if the market prices the bid using the tree structure in Figure 1, then the bid-announcement-induced abnormal stock return, $\mathbf{\Gamma}$, equals the product of the outcome-probabilities and payoffs: $\mathbf{\Gamma} = \mu' \mathbf{p}(\mathbf{x})$.

Below, we first estimate $\mathbf{p(x)}$ using multinomial logit. Second, we estimate $\mathbf{\Gamma}$ for each takeover bid using the time-series of bidder and target stock returns. Third, we recover the vector μ embedded in the estimate of $\mathbf{\Gamma}$ by a (normalized) cross-sectional regression of $\mathbf{\Gamma}$ on $\mathbf{p}(\mathbf{x})$. Finally, we use the estimates to form the predicted value of the bid, $\mathbf{\Gamma}(\mathbf{x}) \equiv \mu'\mathbf{p}(\mathbf{x})$ and compute the derivative $\partial\Gamma(\mathbf{x})/\partial\mathbf{x}$, thus allowing examination of the marginal impact of the offer parameters on the expected value of the bid.

This entire analysis is performed first using the information available at the beginning of the contest only (Stage 1 in the contest tree), and subsequently repeated using the (updated) information available at the arrival of the second bid (Stage 2, nodes 3 or 4 of the tree).[13]

3.1 Outcome-probabilities ($\mathbf{p(x)}$)

3.1.1 Econometric procedure

Let $p_{jn}^s \equiv p_n^s(\mathbf{x_j})$ denote the probability that bidder j will reach node n from node s in the contest tree, conditional on the offer characteristics $\mathbf{x_j}$. We estimate p_{jn}^s using multinomial logit. With a total of $\mathcal{E}^s$ possible nodes in Figure 1 following node s, the multinomial model is given by

$$p_{jn}^s = \exp(\mathbf{x_j}'\delta_n^s) / \sum_{n \in \mathcal{E}^s} \exp(\mathbf{x_j}'\delta_n^s) \tag{3}$$

where δ_n^s is a K-vector of parameters. At Stage 1 in the event tree, there are a total of $\mathcal{E}^0 = 4$ nodes (i.e., nodes 1 - 4). At Stage 2 there are $\mathcal{E}^3 = 3$ nodes (nodes 5 - 7) when one arrives from node 3, and $\mathcal{E}^4 = 3$ nodes (nodes 8 - 10) conditional on arriving from node 4. At each stage of the contest tree, there are a total of $K\mathcal{E}^s$ different parameters to be estimated.

The multinomial model in (3) differs from the binomial (two-outcome) probability estimation typically reported in the literature. Several papers present binomial probability estimates for what is essentially a subset of the outcomes in Figure 1, such as the probability of success vs. failure, and the probability of competition vs. single-bid auction.[14] By inspection of Figure 1, the former probability estimates excludes the no-bidder-wins outcome, while the latter excludes bid revisions

[13]One could in principle update the estimates at each of the (up-to 11) new bids. However, as discussed below, we find that the offer characteristics $\mathbf{x}$ affect the outcome-probabilities only at Stage 1. Thus, our Stage 1-and-2 estimation captures the essence of the impact of $\mathbf{x}$.

[14]See, e.g., Walkling and Long (1984), Walkling (1985), Jennings and Mazzeo (1993).

by the initial bidders as a separate outcome. Binomial estimates that omit relevant outcomes are biased (Maddala (1983)). Our research indicates that *all* of the nodes in Figure 1 are statistically relevant and the structural analysis thus requires multinomial estimation.

Equation (3) cannot be estimated directly as the parameters δ_n^s are determined only up to an additive constant (i.e., one can add a constant α to each δ_n^s without altering the estimated value of p_{jn}^s). The solution is to fix the set of parameters associated with one of the outcomes, and rescale the remaining parameters relative to that "numeraire" outcome. For the Stage 1 probability estimates, we select node 1 (unsuccessful single-bid contest) as the numeraire outcome. Similarly, the "no bidder successful" outcomes (nodes 7 and 10) are numeraire events for the probability estimates in Stage 2 of the event tree. Let $\dot{\delta}_n^s$ denote the parameter value rescaled in this manner. Thus, at Stage 1 of the tree, $\dot{\delta}_1^0 = 0$, and $\dot{\delta}_n^0 = \delta_n^0 - \delta_1^0$, for $n > 1$. The multinomial logit model used for Stage 1 estimation is then:

$$p_{j1}^0 = 1/[1 + \sum_{n=2}^{4} \exp(\mathbf{x_j}'\dot{\delta}_n^0)], \tag{4}$$

$$p_{jn}^0 = \exp(\mathbf{x_j}'\dot{\delta}_n^0)/[1 + \sum_{n=2}^{4} \exp(\mathbf{x_j}'\dot{\delta}_n^0)] \quad \text{for} \quad n = 2, ...4, \tag{5}$$

The multinomial logit equation is similarly defined for the Stage 2 estimation of the outcome-probabilities.[15]

3.1.2 Parameter estimates

Table 7 reports estimates of the coefficient vector δ_n^s as well as the average probability estimates. At Stage 1 ($s = 0$) the vector of offer characteristics $\mathbf{x}$ includes the initial offer premium (*Premium*), the initial toehold (*Toehold*), and dummy variables for zero-toehold (*Zero-Toe*), cash as payment method (*Payment*), and the presence of a negotiated pre-bid tender agreement (*Negotiated*). At

[15] Generally, the likelihood function is determined by defining an index y_{jn}^s which equals 1 if bid j results in node n from node s, and zero otherwise. Then for a total of $\mathcal{E}^s$ nodes and N bids, the likelihood function is

$$L^s = \prod_{j=1}^{N} \prod_{n \in \mathcal{E}^s} p_{jn}^{y_{jn}^s},$$

which (with the logit function) has a unique maximum. Note also that a (Hausman) test fails to reject the "independence of irrelevant alternatives" assumption underlying the multinomial logit model for our contest tree. See Hausman and Wise (1977) and Maddala (1983).

Stage 2 ($s = 3, 4$), $\mathbf{x}$ is augmented by the dummy variable *Hostile* indicating observed target management opposition to the initial bid. Moreover, Stage 2 regressions use as *Premium* the second offer price relative to the target share price on day -60, and *Toehold* is now the second bidder's initial toehold level.

The values of the likelihood-ratio test statistics (LRT) in Table 7 indicate that the Stage-1 parameter estimates are jointly highly significant (LRT=300.55 with 15 degrees of freedom).[16] In contrast, Stage-2 estimates are largely insignificant whether estimated from node $s = 3$ or node $s = 4$. In other words, the offer parameters included in $\mathbf{x}$ have a significant impact on the subsequent transition probabilities only at the first stage of the contest ($s = 0$). After the initial bidder finds it necessary to revise upwards the initial bid (node $s = 3$), or when the initial bid attracts competition (node $s = 4$), it appears that the strategic impact of the offer parameters on the subsequent outcome-probabilities is limited. The only exception to this is the coefficient for $Negotiated$ which shows that a pre-initial-bid tender precommitment significantly reduces the probability that a rival bidder will win the contest also after the rival bid has emerged.

Since the probabilities at each stage sum to one, the parameters δ_n^s reported in Table 7 do not represent partial derivatives of the probabilities with respect to each of the offer characteristics. That is, a change in the kth offer characteristic changes *all* the probabilities simultaneously, so that the partial for one probability becomes

$$\partial p_n^s / \partial x_k = p_n^s (\delta_{kn}^s - \sum_{e \in \mathcal{E}^s} \delta_{ek}^s p_e^s). \tag{6}$$

Table 8 shows the value of this partial derivative for all the probabilities and all the offer characteristics, along with the imputed t-statistics. At Stage 1 (the initial bid), the probability of a successful initial bid (p_2^0) increases with $Premium$, $Toehold$, and $Negotiated$, while the variables $Toehold$ and $Negotiated$ also significantly decreases the probability of multiple bids in the contest. There is evidence of a non-linear impact of $Toehold$ on the probability of multiple bids, as $Zero - Toe$ receives a significantly negative coefficient in the estimation of p_2^0 and p_3^0.

[16] The likelihood ratio test (LRT) compares the performance of the model to a model with only constants. The tst is distributed χ^2 with degrees of freedom equal to the number of additional explanatory power.

At Stage 2 (the second bid), there is evidence that greater toeholds positively affects the probability that the initial bidder will be successful, conditional on making the second bid in the contest. Moreover, when the second bid in the contest is made by a rival bidder, the probability of rival bidder success is significantly lower if the rival bidder's toehold is zero. Interestingly, the value of the (revised) offer premium in the second bid has no statistically significant impact on the subsequent success probabilities. It is also interesting that target management opposition (*Hostile*), which is known at this time, also has no significant impact on any of the Stage-2 probabilities.

As shown in Panel III of Table 8, having obtained a tender pre-commitment from target management or a large shareholder prior to the initial bid is clearly of value if the contest develops rival bids. When the second bid in the contest is coming from a rival bidder, the presence of a tender pre-commitment tends to increase the initial bidder's chance of eventually succeeding (p_8^4) and significantly reduces the chance of the rival bidder being successful (p_{10}^4).

3.2 Offer-induced abnormal stock return (Γ)

3.2.1 Econometric procedure

The stock prices of the bidder and the target firms react to each new offer announcement in a given contest by generating an abnormal return Γ relative to its pre-offer price. Since the both the number of bids and the number of days between bids vary across contests, we use the flexible "variable-window" estimation procedure in Eckbo and Langohr (1989) to estimate Γ. In Eckbo and Langohr (1989), the average daily abnormal return over event window w, γ_{jw}, is estimated directly as a parameter in the following market model:

$$r_{jt} = \alpha_j + \beta_j r_{mt} + \beta_j' d_{mt} r_{mt} + \sum_{w=1}^{W_j} \gamma_{jw} d_{jwt} + \epsilon_{jt}, \tag{7}$$

where, r_{jt} is the continuously compounded rate of return to firm j over day t, r_{mt} is the continuously compounded rate of return on the value weighted market index over day t, d_{mt} is a dummy variable which equals one if day t is greater than or equal to day -60 relative to the announcement of the initial bid in the contest, and zero otherwise, d_{jwt} is one of W_j dummy variables, where each dummy takes on a value of one if day t is within event window w and zero otherwise,[17] and ϵ_{jt} is a regression error term, assumed to be normally, identically and independently distributed.[18]

Letting ω_{jw} denote the number of trading days within event window w for contest j, then the cumulative abnormal return over the w'th window is given by $\omega_{jw}\gamma_{jw}$. As discussed below, there is evidence of significant average abnormal stock price behavior as early as 60 days prior to initial bids, thus we start the cumulation at day I-60. The total abnormal return from event day -60 through node s in the contest tree is given by

$$\Gamma_{js}^{-60} \equiv \sum_{w=1}^{s^*} \omega_{jw}\gamma_{jw}, \tag{8}$$

where s^* is the event window in calendar time that ends with node s. For example, when we look a the initial bid ($s = 0$), $s^* = 2$ and Γ_{j0}^{-60} cumulates over event parameters γ_{j1} and γ_{j2}. The estimation uses OLS with White's heteroscedastic-consistent covariance matrix.[19] The estimation period starts 191 days prior to the announcement of the initial bid and ends 191 days following the ending date of last bid (abnormal returns were also estimated using a longer period (-381, 381,) without altering the conclusions).

3.2.2 Parameter estimates

Table 9 shows the average cumulative abnormal returns to targets, the initial bidder and rival bidders from day -60 relative to the announcement of the first bid in the contest through node s

[17] The length of each event window captured by dummy variables (d_{jwt}) is as follows. For all contests, the first event window (defining d_{j1t}) is the 59-day period [I-60, I-2] relative to the announcement of the initial bid (I=day 0), and thus reflects possible pre-announcement rumors about the pending offer. The second event window (d_{j2t}) is the two-day period [I-1, I], reflecting the news of the initial bid in the Wall Street Journal. Each subsequent bid in multiple-bid contests adds two event windows, one covering the interim period from the day after the previous offer announcement day through day -2 relative to the new bid, and another covering the two-day window [-1, 0] for the new bid. Finally, the three last event periods (for both single-bid and multiple-bid contests) cover (i) the interim period from the last bid to day E-2, where E is the contest expiration date, (ii) the three-day window [E-1, E+1] centered on the expiration day, and (iii) the post-expiration window [E+2, min(T,E+20)], where T is the time of target delisting after a successful takeover. In sum, there are a total of 5 event windows in the case of a single-bid contest. Generally, with L_j bids the total number of event windows for contest j is $W_j = 5 + 2(L_j - 1)$. For example, with 3 bids, which is common in multiple-bidder contests, the total number of event windows is $W_j = 9$.

[18] Abnormal returns were also estimated assuming ϵ_{jt} follows an autoregressive conditional heteroscedasticity process of order one (ARCH(1)), i.e., where $Var(\epsilon_{jt}) = \alpha^0 + \alpha^1 Var(\epsilon_{j,t-1})$. The results of the ARCH model are qualitatively similar to the OLS-based results and are therefore not reported.

[19] White (1980) demonstrates that the variance of the coefficient estimates b can be estimated as $\hat{\sigma}^2(b) = N(X'X)^{-1}S'(X'X)^{-1}$, where X is the matrix of independent variables and N is the number of observations in the estimation. In this case $S = \sum_i e_i^2 x_i x_i'$ where e_i is the i^{th} least square residual. The estimated variance allows appropriate inferences without specifying the form of the heteroscedasticity.

in the contest tree, Γ_s^{-60}, $s = 0, 1, .., 10$. The total contest period extends from day -60 relative to the Wall Street Journal announcement of the initial bid through 20 days following the ending date of the contest. The time series of abnormal returns for targets, the initial bidder and the second (rival) bidder (if any) from day -80 through day 10 following the initial bid is shown in Figure 3.

Cumulative abnormal returns up through the initial bid (Stage 1) average 32.48% for target firms, with a strongly significant Z-value of 33.39.[20] In single-bid contests, the average abnormal return remains at 32% if the target is successful, and it drops to 15.79% by the unsuccessful outcome date. In multiple-bid contests, by the time of the second bid (Stage 2), target average abnormal returns increases to 40.69% if the second bid is made by the initial bidder, and to 42.88% if the second bid in the contest is made by a rival bidder. At stage 3, ultimately successful targets realize on average 47.78% if the initial bidder wins the contest, while the total abnormal return is 37.91% if the initial bidder eventually loses out to a rival. Finally, if no bidder wins, target average abnormal returns drop to 23.56%. In sum, successful targets shareholders earn large and significant total abnormal returns which are higher in multiple-bid than in single-bid contests. In addition, target abnormal returns are on average highest when it is the initial bidder that eventually wins the auction.

In contrast, both the initial and rival bidders on average make insignificant abnormal returns, with one exception in Table 9: Rival bidders earn on average a significant 6.11% abnormal return up through the date of the second bid in the auction, provided the second bid is made by the initial bidder (node $s = 3$). This gain possibly reflects information about the target as a potential profit opportunity for rival bidders, revealed by the two first bids in the contest. This initial gain to rival bidders is reversed by the time it is clear that the initial bidder wins the contest: cumulative abnormal returns to rivals average an insignificant 3.14% at nodes $s = 5$ and $s = 8$.

The evidence in Table 9 is consistent with the proposition that competition among bidder firms

[20] The Z-statistic is for the hypothesis that the average cumulative abnormal return equals zero, where $Z_s = (1/\sqrt{N}) \sum_{j=1}^{N} \Gamma_{js}^{-60} / \sigma_{\Gamma_{js}}$, which has a standard normal distribution for large sample size N. The variance of Γ_{js}^{-60} is $\sigma_{\Gamma_{js}}^2 = \sigma^2 R(X'X)^{-1} R'$, where σ^2 is the regression residual variance, R is a vector in which $R_t = 1$ if any $d_{jnt} = 1$, and X is the matrix of independent variables in the market model (6). The conclusions of this paper also reflects the results of tests of the joint hypothesis that all the abnormal returns across firms are equal to zero using the Hochberg (1988) and Simes' (1986) modified Bonferroni techniques.

grants most (if not all) of the rents from merger activity to target shareholders. However, it is also widely recognized that partial anticipation of takeover activity and relative size of the bidder and target firms may produce attenuated estimates of total bidder gains.[21] The question remains, however, whether expected gains to bidders, conditional on the offer parameters, are positive for any of the nodes in the tender offer contest tree. The subsequent analysis sheds light on this issue as well.

3.3 Conditional expected value of bid ($\Gamma(\mathbf{x}) \equiv \mu'\mathbf{p}(\mathbf{x})$)

3.3.1 Econometric procedure

As pointed out earlier, given the assumed contest tree structure, rational pricing implies that the market impounds the abnormal return $\mathbf{\Gamma} = \mu'\mathbf{p}(\mathbf{x})$ into the firm's stock price upon the bid announcement. That is, the market reaction to a bid announcement represents the sum of the products of outcome-probabilities and payoffs across all subsequent nodes in the contest tree. We have so far estimated, for each bid j, the value of Γ_j and $\mathbf{p}(\mathbf{x_j})$. We now extract the vector of average payoffs μ through a cross-sectional regression of Γ_j on $\mathbf{p}(\mathbf{x_j})$. Note that since the market reaction to *every* bid contains information on the subsequent values of μ and $\mathbf{p}(\mathbf{x})$, this forward-looking regression uses all sample bids.[22] As a result, our regression estimates of μ differ from the traditional average abnormal return estimates reported in Table 9 as well as in the literature generally.[23]

In order to reduce multicollinearity and improve efficiency, we normalize the regressor $\mathbf{p}(\mathbf{x})$ by the probability of the numeraire outcome n^*. As in the probability estimation above, n^* is taken to be the unsuccessful outcome. Thus, at Stage 1 of the contest tree, $n^* = 1$, and at

[21] Eckbo and Thorburn (1999) present large-sample evidence that the measured gains to bidders tend to increase when the total equity size of the bidder relative to the target decreases.

[22] The probability estimates reported above are generated assuming stationarity over the sample period. As shown in an earlier draft, subperiod estimations provide similar inferences.

[23] The traditional average abnormal return estimates are analogous to parameters $\underline{\mu}$ obtained by regressing Γ on a vector $\mathbf{d}$ of dummy variables that takes on a value of one corresponding to the (*ex post* known) outcome and zero otherwise. For example, if Γ is defined as the abnormal return induced by the offer announcement, then $\underline{\mu}$ is estimated with hindsight (since $\mathbf{p}(\mathbf{x}) \equiv \mathbf{1}$) and it ignores the bid information $\mathbf{x}$. Thus, traditional abnormal return estimates cannot be used to compute the marginal change in the expected value of a bid from a marginal change in the bid structure. Moreover, traditional abnormal return estimates represent relatively *noisy* estimates of the various payoffs since abnormal returns must be cumulated over the entire tender offer contest period and are thus affected by random events following the bid announcement.

Stage 2, $n^* = 7$ when arriving from node 3, and $n^* = 10$ when arriving from node 4 in Figure 1. Dividing through $\mathbf{p}(\mathbf{x})$ by the numeraire outcome produces a vector containing a constant (for the numeraire outcome) and a set of *odds* in favor of each of the remaining outcomes: $\mathbf{p}(\mathbf{x})/p_{n^*}$. Using a logarithmic transformation for the odds, and dropping the vector notation, yields the following cross-sectional regression specification:

$$\Gamma_{js} = \mu_r^s + \sum_{n \in \mathcal{E}^s, n \neq n^*} \mu_n^s \ln(\frac{p_{jn}^s}{p_{jn^*}^s}) + \epsilon_j, \quad j = 1, .., N, \tag{9}$$

where ϵ_j is a random variable reflecting the estimation error in Γ_{js}.

Note that, in equation (9), the slope coefficient μ_n^s represents the marginal change in the bid's expected return by changing the log-odds in favor of outcome n.[24] Moreover, the constant term μ_r^s equals the expected value of a bid for which all the log-odds are equal to zero. This is a bid that generates *equal probabilities* for all outcomes (so that the odds equal 1), which we refer to as the *reference bid.* In other words, the payoff estimates μ_n^s measure the change in payoffs resulting from altering the log-odds (through the offer configuration $\mathbf{x}$) relative to the reference bid.

We perform the above cross-sectional regression at each stage s of the contest tree:

$$\begin{aligned}
s = 0: \quad \Gamma_{j0}^{-60} &= \mu_r^0 + \textstyle\sum_{n=2}^4 \mu_n^0 \ln(\frac{p_{jn}^0}{p_{j1}^0}) + \epsilon_{j0}, \\
s = 3: \quad \Gamma_{j3}^{-60} &= \mu_r^3 + \textstyle\sum_{n=5}^6 \mu_n^3 \ln(\frac{p_{jn}^3}{p_{j7}^3}) + \epsilon_{j3}, \\
s = 4: \quad \Gamma_{j4}^{-60} &= \mu_r^4 + \textstyle\sum_{n=8}^9 \mu_n^4 \ln(\frac{p_{jn}^4}{p_{j10}^4}) + \epsilon_{j4}.
\end{aligned} \tag{10}$$

Each equation is estimated separately, in conjunction with the associated probability estimates. We report estimates using a two-step procedure, where Γ_{js}^{-60} and the probabilities p_{jn}^s are estimated in the first step and the payoffs μ_n^s from the corresponding equation in the above system in the

[24]The logarithmic form of the odds regressors makes it possible to interpret the coefficients μ_n^s as partial derivatives with respect to changes in the odds, despite the fact that the probabilities themselves sum to one. For example, starting with the reference bid at Stage 1, suppose we increase p_2/p_1 to 2, holding the remaining odds constant at one. The new probabilities are $p_2 = .4$ and $p_1 = p_3 = p_4 = .2$, i.e., with the remaining three odds unchanged. More generally, define $r_n^s = \ln(p_n^s/p_1^s)$, $n > s$. Thus, $p_n^s = p_1^s \exp(r_n^s)$ and, since the probabilities sum to one, $p_1^s = 1/\sum_{n>s, n\neq 1} \exp(r_n^s)$. Consequently, as one changes one of the log-odds, all the probabilities change, however, the remaining log-odds remain fixed.

second step.[25]

Moreover, the predicted value (abnormal return) of an offer with characteristics $\mathbf{x}$, $\hat{\Gamma}_s(\mathbf{x})$, is computed as

$$\hat{\Gamma}_s(\mathbf{x}) = \hat{\mu}_r^s + \sum_{n \in \mathcal{E}^s, n \neq n^*} \hat{\mu}_n^s \ln(\frac{p_n^s(\mathbf{x})}{p_{n^*}^s(\mathbf{x})}), \tag{11}$$

where $\hat{\mu}_r^s$ is estimated using system (10). Finally, we also report the partial derivative of the predicted offer value with respect to the k'th offer parameter, $\partial\hat{\Gamma}_s/\partial x_k$, which is given by

$$\partial\hat{\Gamma}_s(\mathbf{x})/\partial x_k = \sum_{n \in \mathcal{E}^s, n \neq n^*} \hat{\mu}_n^s \hat{\delta}_k^s, \tag{12}$$

where $\hat{\delta}_n^s$ is the vector of parameter estimates from the multinomial logit model. This expression for the partial derivative uses the fact that the odds $(p_n^s/p_{n^*}^s)$ equal $\exp(\mathbf{x_j}'\delta_n^s)$ and the log-odds equal $\mathbf{x_j}'\delta_n^s$.

3.3.2 Estimated values

Table 10 reports weighted-least squares, two-step estimates of the payoffs μ_n^s defined in system (10). Note that, when the true payoff is positive, the log-transformation of the odds will produce a negative coefficient μ_n^s whenever the average odds is less than one. There are three such cases in Table 10 [see $\ln(p_6^3/p_7^3)$ in Panel II and $\ln(p_8^4/p_{10}^4)$ in Panel III] and, to clearly signal these cases, the table also reproduces the value of the mean log-odds associated with each node in the regression.

The regressions in all three panels of Table 10 are highly significant for targets (adjusted regression R^2's are ranging from .14 to .32), while they are generally much less significant for bidders. For the 753 targets at Stage 1, payoffs are positive and significant for all three outcomes ($n = 2 - 4$). This indicates that an offer which increases (relative to the reference bid) the log-odds in favor of outcomes 2-4 significantly increases target payoffs. Outcome 2 (successful single-bid contest) has the greatest target payoff, with a highly significant $\hat{\mu}_2^0 = .29$ (t-value 17.69). When the contest

[25] In an earlier draft, we also reported results of a joint estimates of the payoffs and the probability (a system of two "seemingly unrelated" (SUR) equations, the first the multinomial model and the second the appropriate equation in system (10). The joint estimation avoids the errors-in-variables that is present in the two-step estimation procedure. The joint estimation further restricts the sample, and we experienced some convergence problems. However, the evidence from the joint estimation appears consistent with the results reported here. We also re-estimated the system (10) with different numeraire outcomes for the definitions of the odds-ratio. Altering the numeraire outcome has little impact on the payoff-estimates.

develops multiple bids, the target payoff-estimates are $\hat{\mu}_3^0 = .19$ (t=13.74) for the event that the second bid is made by the initial bidder, and $\hat{\mu}_4^0 = .05$ (t-value 5.39) when the second bid in the auction is made by a rival bidder.

Target payoffs at Stage 2 of the contest tree are also for the most part large and significant, as expected. For example, Stage 2 estimation from "second bid by initial bidder" produces $\hat{\mu}_6^3 = -.28$ (t=-5.83) for "rival bidder successful" (which represents a positive average payoff since the mean log-odds is negative). Moreover, stage 2 estimation from "second bid by rival bidder" yields $\hat{\mu}_8^4 = .18$ (t=6.97) for the "initial bidder successful" outcome, and $\hat{\mu}_9^4 = .09$ (t=3.31) for the "rival bidder successful" outcome.

As indicated earlier, there is little evidence of significant payoffs to bidders throughout Table 10. There is one exception, however, in panel II of the table, which shows a significant bidder payoff for the outcome where a rival bidder wins the auction (node $n = 6$). As for targets, the average log-odds is negative in this regression, so that the payoff is actually positive. Positive initial bidder gains when the initial bidder loses the contest to a rival is consistent with negative initial bidder gains when the outcome is successful. However, since there is no evidence of negative bidder payoffs in the successful states, nor is there evidence of a positive bidder payoff when the target rejects *all* bids, the significantly positive value of $\hat{\mu}_6^3$ most likely reflects expected gains from selling the toehold to the successful rival bidder. As was shown in Table 2, when the initial bidder loses to a rival, the rival purchases the initial bidder's toehold (or, in a partial bid, a pro-rated portion of the toehold) at a premium which averages 73% over the pre-offer target share price.

We now turn to the predicted offer values, conditional on the vector of offer characteristics $\mathbf{x}$, $\hat{\Gamma}(\mathbf{x})$, shown in Table 11. To reiterate, this is the offer value computed using the estimated parameters in Table 10 and a given offer configuration $\mathbf{x}$. The first three columns of Table 11 shows predicted offer values for three alternative bid structures, while the last six columns lists the partial derivatives $\partial\hat{\Gamma}_s(\mathbf{x})/\partial x_k, \quad s = 0, 3, 4, \quad k = 1, .., 6$. Thus, this table addresses questions concerning the impact on the expected value of a bid from, e.g., increasing the toehold, fully accounting for the payoffs as well as the marginal impact of the toehold-increase on the relevant outcome-probabilities.

Note that because the payoffs for bidder firms in Table 10 are statistically insignificant (with the one exception noted above), Table 11 shows results for target firms only.

The first column of Table 11 shows the expected value of the reference bid by repeating the constant term μ_r^0 from the regressions in Table 10. Notice first the significantly negative value of the reference bid for targets in Panel I (μ_r^0=-.24, with a t-value of -8.85 as shown in Table 10). In other words, the expected value to target shareholders of the reference bid is lower than the expected value of the average bid in the sample. The explanation for this is that the reference bid places a higher probability (equal to .25) on the "target unsuccessful" outcome at Stage I of the contest tree (node 1 in Figure 1): Recall from Table 7 that the average sample probability of this outcome is only .11. Moreover, we reported earlier that the average abnormal return to targets from day -60 through the unsuccessful outcome at node 1 is only .16 (Table 9), which is substantially lower than the average abnormal return to the various successful outcome nodes in the contest tree. In sum, by placing too much weight on the relatively low-payoff, unsuccessful outcome, the expected value of the reference bid, relative to the average bid in the sample, is negative.

Our finding of a negative target expected payoff from the reference bid is interesting in light of the evidence in Bradley, Desai and Kim (1983) of a reversal of initial gains to ultimately unsuccessful targets. Target losses in the unsuccessful outcome nodes of the contest tree are consistent with the hypothesis that takeover gains anticipated prior to the offer date (over the period from day -60 through day 0) are conditioned on a control change in the target firm. Note, however, the methodological difference: While Bradley-Desai-Kim arrive at their conclusion based on average abnormal returns in a subsample of ex post unsuccessful targets (much as in our Table 9), our inferences are based on the estimated *expected* payoff to the reference bid. In our analysis, this expectation is a product of the estimated outcome-probabilities and the cumulative abnormal returns from day -60 through day 0 across *all* bids in the sample.

The second and third columns in Table 11 show the expected payoffs to target shareholders of (1) the bid which produces the average estimated log-odds, $\bar{\ln}(p_n^s/p_{n^*}^s)$, and (2) the bid which generates the average estimated probabilities $\bar{p}_n^s(\mathbf{x})$. For target firms at Stage I (the initial bid), the value of $\hat{\Gamma}_s^{-60}(\mathbf{x})$ is .24 for the former offer and .34 for the latter offer type. Recall also from Table 9 that the average target abnormal return from day -60 through the offer announcement day (Γ_0^{-60}) is .33. Thus, when we combine the payoff-estimates from Table 10 with the average estimated outcome-probabilities, we generate an expected offer value which is very close to the unconditional sample average abnormal return for target firms at the initial stage of the contest.

The partial derivatives $\partial\hat{\Gamma}_s(\mathbf{x})/\partial x_k$ shown in Table 11 are also interesting. As expected, raising the offer price increases the expected return to targets whether it is at the first or at the second bid in the contest. However, if the initial bidder increases the toehold, the expected value of the offer to target shareholders is generally reduced at the time of the first bid, and increased at the time of the second bid. The reduced target value from an increase in the toehold at the time of the initial bid reflects the significantly positive impact of the toehold on the probability of single-bid success (which generates lower target gains) shown earlier in Table 8. The increased target value of a larger bidder toehold at the time of the second bid most likely reflects the finding (Table 8) that greater toeholds at this stage reduces the probability of an altogether unsuccessful target (nodes 7 and 10 in the contest tree). It is also interesting to note that the presence of a negotiated tender-agreement increases the expected value of the offer to target shareholders at the initial offer but not at the second bid.

Finally, the results indicate that target management resistance *reduces* the expected value of the second bid in the tender offer contest, whether the second bid is made by the initial or by the rival bidder. In other words, target shareholders are better off (in terms of the expected value of the bid) if the initial bid attracts competing offers without target management signaling a hostile reaction to the initial bid.

4 Conclusions

Corporate takeover bids occur in sequential auctions that have a variety of potential outcomes. This paper designs an empirically tractable contest tree structure capturing much of the complexity of such auctions. With a sample of 2,335 bids in 1,353 tender offer contests over the post-Williams

Act period 1971-1990, we estimate outcome-probabilities throughout the contest tree as a function of key decision variables under the bidder's control. These include the offer premium, the toehold, the payment method, and whether or not the bidder negotiates a partial tender-agreement with a major target shareholder. We then use the estimated outcome-probabilities to generate payoff-estimates embedded in the market reaction to the initial and second bid announcements. The latter estimation exploits the notion that the market reaction to a bid announcement represents the sum of the product of outcome-probabilities and payoffs across every node in the contest tree. The estimation permits a systematic examination of the marginal impact of various offer parameters on expected payoffs to bidder and target firms, using only information available at the time of the bid.

Our information on the duration, bid-jumps and success rates in tender offer contests can be summarized as follows:

> **Contest duration and bid-jumps:** (C1) The average single-bid contest lasts 40 days, while the average duration for multiple-bid contests is 70 days. (C2) In multiple-bid contests, the number of bids ranges from 2 to 12, with an average of 3. (C3) The average number of days between the first and second bid is 15, and the typical bid-jump from initial to second bid is 10% representing a premium increase of 31%. (C4) Offer premiums in successful single-bid contests are on average higher than the average initial offer premium in multiple-bid contests. (C5) The initial bidder's rate of success is 78% in single-bid contests but only 41% when the first bid attracts competition.

The relatively rapid entry of a competing bid, combined with the large bid-jump (C3), suggest that tender offer contests has has common value elements (rival bidders quickly determine their own valuation of the target) and that bidding is costly (making large bid-jumps optimal). We also find that the initial bidder frequently revises the initial bid before the entry of a rival bidder, possibly to avoid a negative reaction to the bid by the target board. Result (C4) is consistent the model of Fishman (1988) in which the relatively high-value initial bidders in private value auctions with costly bidding raises the bid to deter competition.

We also show that toehold effects are significant:

Bidder toeholds: (T1) Of the 1,353 initial bidders, only 53% have toeholds. Initial bidder toeholds are largest in single-bid contests (average 20%) and lowest in multiple-bid contests (average 5%). (T2) In multiple-bidder contests, the initial and rival bidders on average enter with similar toehold levels. (T3) Toeholds and offer premiums are negatively correlated, and toeholds are smaller the greater the pre-bid runup in the target share price. (T4) Greater toeholds increase the probability of single-bid success, and lowers both the probability of rival bidder entry and target management resistance.

These results have implications for bidding models focusing on the toehold decision. For example, (T1) and (T4) are consistent with multiple-bidder models in which acquiring a toehold provides a competitive advantage (e.g., Burkart (1995), Singh (1998), and Bulow, Huang and Klemperer (1999)). As argued by Bulow, Huang and Klemperer (1999), in common-value auctions, (T2) implies the greatest level of competition among rival bidders and may therefore be the result of a deliberate target "level-the-playing-field" strategy. However, our evidence on pre-bid target tendering agreements does not support this conjecture. The first part of (T3) is consistent with Shleifer and Vishny (1986) and Hirshleifer and Titman (1990) but inconsistent with Chowdry and Jegadeesh (1993). The second part of (T3) is inconsistent with the model of Ravid and Spiegel (1999).

Multinomial logit estimation of the probabilities for each of the nodes in the contest tree in Figure 1 reveals the following:

Contest tree outcome-probabilities: (P1) The offer premium, toehold, and the pre-bid tender agreement all significantly affect the outcome-probabilities, while the payment method is insignificant. (P2) The impact of the offer parameters on the outcome-probabilities is almost exclusively restricted to the initial bid in the contest. (P3) At the initial bid, the derivative of the probability of single-bid success is positive with respect to the offer premium, the toehold and the pre-bid tender agreement.

The insignificance of the payment method (P1) differs from previous studies such as by Walkling (1985), Asquith (1992), and Jennings and Mazzeo (1993), who find some evidence that use of cash increases the probabiulity of a succsessful bid. Also, Jennings and Mazzeo (1993) report that the probability of a competing bid increases with the proportion cash used in the initial bid. However, Jennings-Mazzeo and others presents binomial probability estimates which omits relevant branches of Figure 1 and which therefore are biased. Moreover, since they do not include all the remaining four offer parameters, our finding may simply indicate that the effect of the payment method is small when considered jointly with the remaining offer parameters. Results (P2) and (P3) are also new, produced by the sequential nature of our probability estimation.

Finally, our *ex ante* payoff estimates at each node across the contest tree can be summarized as follows:

> **Contest tree payoffs and expected value of bid**: (S1) Target payoffs are positive and large in all successful nodes in the contest tree, and greater when the initial bid attracts competition. (S2) An offer that generates a higher-than-average probability of an unsuccessful single-bid contest has a much lower expected value to target shareholders than an offer generating average outcome-probabilities. (S3) Increasing the offer premium increases the expected value of the offer to target shareholders, while increasing the initial bidder's toehold reduces target payoffs. (S4) Target management resistance reduces the expected value of the second bid to target shareholders. (S5) The expected payoff to initial bidders is insignificantly different from zero, as are bidder payoffs for all the successful states. (S6) Expected payoff to initial bidders is significantly positive when a rival bidder wins the auction, most likely reflecting the expected gain from the ensuing toehold-sale to the successful rival.

Result (S1) is consistent with results reported by Bradley, Desai and Kim (1988) for their sample of 236 successful tender offers. (S2) is consistent with a target management entrenchment hypothesis under which takeover gains require a transfer of control to new management. This inference is qualitatively similar to that of Bradley, Desai and Kim (1983) who find that share prices of *ex post* unsuccessful targets tend to fall back to their pre-offer levels. However, (S2) provides new information because it is founded on the market reaction to the *initial* offer announcement and does not use hindsight. Result (S3) is explained by the finding that an increased toehold at the initial stage of the contest increases the probability of single-bid success, which in turn are associated with lower target payoffs. The negative effect of toeholds on target payoff is consistent with Jarrell and Poulsen (1989) and Eckbo and Langohr (1989) but contradicts Franks and Harris (1989) and Stulz, Walkling and Long (1990). Result (S4) indicates that target shareholders are better off with a second bid that materializes without target management having resorted to hostilities vis-a-vis the takeover attempt. Finally, our structural estimation also sheds new light on the controversial issue of gains to bidder firms. Abnormal returns to bidder firms are typically found to be insignificantly different from zero in the literature. Result (S5) is consistent with results reported elsewhere. However, (S6) possibly reflects gains from selling the target toehold at a premium to the winning rival bidder, which in turn reinforces the value to bidders of acquiring toeholds.

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Table 1
The Number of Takeover Contests Classified by the Number of Bidders and by the Final Outcome of the Contest, 1971-1990.

	Single Bid Contests[a]			Multiple Bid Contests[a]: 2^{nd} bid by initial bidder				Multiple Bid Contests[a]: 2^{nd} bid by rival bidder				Contest	Bidder Firms	Takeover Bids
Year	S	U	All	S	SR	U	All	S	SR	U	All	**Total**	**Total**	**Total**
71	10	9	19	0	0	0	0	0	0	0	0	19	18	19
72	8	10	18	0	0	0	0	0	1	0	1	19	20	20
73	34	17	51	2	0	0	2	1	3	0	4	57	60	67
74	35	16	51	5	0	4	9	3	6	2	11	71	78	104
75	15	8	23	7	1	0	8	1	1	0	2	33	32	48
76	36	13	49	4	3	0	7	2	10	1	13	69	80	112
77	42	26	68	11	2	9	22	2	4	4	10	100	116	157
78	57	5	62	15	2	5	22	2	3	0	5	89	95	132
79	54	4	58	5	5	0	10	4	9	1	14	82	101	123
80	31	2	33	2	1	0	3	2	6	1	9	45	53	62
81	32	8	40	6	2	3	11	3	10	1	14	65	78	118
82	25	5	30	11	2	3	16	3	11	0	14	60	80	121
83	14	6	20	7	3	0	10	2	7	0	9	39	56	83
84	54	7	61	10	1	8	19	1	13	3	17	97	118	154
85	39	3	42	9	3	5	17	2	14	2	18	77	104	145
86	73	9	82	24	3	6	33	5	16	4	25	140	166	247
87	36	12	48	20	11	6	37	0	13	7	20	105	138	222
88	27	18	45	20	13	15	48	3	8	5	16	109	138	273
89	23	7	30	12	1	3	16	0	9	2	11	57	78	102
90	12	3	15	1	0	3	4	0	1	0	1	20	22	26
71-90	657	188	845	171	53	70	294	36	145	33	214	1353	1631	2335
%	48%	14%	62%	13%	4%	5%	22%	3%	11%	2%	16%	100%		
Maximum Number of bids				11	12	9		6	12	8				
Maximum Number of bidders				3	3	4		4	5	4				
Average Number of bids				2.51	3.87	2.96		3.39	2.99	2.82				
Average Number of bidders				1.08	2.09	1.36		2.11	2.29	2.24				

The sample sources are the Austin data base (14d filings from 1971-1986) and the Simon data base (14d filings from 1986-1990), supplemented with information from the Mergerstat Review and the University of Rochester MERC data base. In order to be included in the sample, there must be a 14d filing for the target firm, and it must be possible to determine the starting date of the contest in the Wall Street Journal index. Furthermore, offers must be for at least $1 million and minimum 5% of the target shares, and the bidder's prior toehold in the target must be less than 80%. Takeover bids are identified from 14d filings as well as from information in the Wall Street Journal Index (WSJI). A takeover *contest* is a group of one or more bids for the same target firm. The 1353 contests involve a total of 1271 different target firms and 1249 *different* bidder firms. Sixty nine targets and 277 bidders were involved in more than one contest. Our sample contains a total of 1457 14d filings for the 1271 targets, i.e., there are multiple filings for some targets. The duration of a contest is determined based on a search of the WSJI over 7 calendar months centered on each reported takeover bid for the target.

[a]Variable definitions: "S": the first bidder wins the contest, "SR": a rival bidder wins the contest, and "U": no bidder wins (target is not taken over). A bidder is classified as successful (wins the contest) if the bid increased the bidder's holding of target shares by at least 5%. In six of the 1353 cases, this definition creates multiple winners. Fortunately, in each case one bidder later went on to acquire a controlling share, which we designate as the successful bidder. In the 774 cases with data available on the percent of the target sought by the bidder, the average percent sought is 66% and the average percent held by the successful bidder after the contest is 83%.

Table 2

Percent Initial and Final Offer Premiums, Classified by Contest Outcome and Target Management Response to the Initial Bid, 1971-1990.

Management Reaction	Single Bid Contests			Multiple bid contests							
				2^{nd} bid by initial bidder				2^{nd} bid by rival bidder			
	S	U	All	S	SR	U	All	S	SR	U	All
				I: Initial Offer Premium							
Target management supportive											
Average	60.02	64.26	60.39	55.69	107.20	29.94	59.98	58.67	46.65	71.67	54.52
Median	54.15	48.14	53.46	45.45	93.81	16.30	45.45	62.61	37.26	66.67	52.99
Sample	237	23	260	8	2	2	12	7	17	6	30
Target management neutral											
Average	50.06	34.84	47.96	48.79	37.3	50.85	47.81	61.022	41.00	22.54	41.22
Median	42.35	25.93	40.50	45.88	36.59	45.46	45.46	49.22	36.75	14.98	37.93
Sample	287	46	333	53	11	21	85	11	56	11	78
Target management opposed											
Average	40.27	38.43	39.21	47.01	46.16	49.45	47.39	48.69	41.93	58.10	45.29
Median	31.58	36.47	35.78	39.56	46.48	47.37	42.59	35.48	34.15	49.99	37.58
Sample	44	60	104	90	37	39	166	14	60	12	86
All contests											
Average	53.46	41.75	51.29	48.10	46.65	49.30	48.1	55.11	42.14	47.48	45.08
Median	45.05	35.78	44.00	43.09	46.19	45.46	44.68	48.15	36.75	42.83	38.29
Sample	568	129	697	151	50	62	263	32	133	29	194
				II: Final Offer Premium							
Target management supportive											
Average				56.30	120.73	43.74	64.94	82.53	57.67	104.24	72.78
Median				59.47	70.87	28.20	59.47	70.21	54.83	111.11	66.58
Sample				8	2	2	12	7	17	6	30
Target management neutral											
Average				61.99	64.71	67.69	63.75	81.83	65.61	32.6	63.24
Median				68.07	62.16	53.99	59.46	66.99	58.89	23.61	54.9
Sample				53	11	21	85	11	56	11	78
Target management opposed											
Average				65.95	73.21	70.99	68.75	90.09	83.02	81.98	84.03
Median				60.60	86.06	72.09	63.08	80.33	72.06	69.11	79.10
Sample				90	37	39	166	14	60	12	86
All contests											
Average				64.05	73.24	68.99	66.96	85.60	72.45	67.86	73.93
Median				60.60	78.55	59.28	62.16	73.05	68.48	53.81	66.72
Sample				151	50	62	263	32	133	29	194

See Table 1 for data sources. All offer premiums are defined relative to the target share price 60 days before the start of the contest. The final offer premium uses the offer price in the final offer in the contest. The sample in this table is restricted to first listed on the CRSP NYSE/AMEX and Nasdaq daily tapes. "S" indicates that the first bidder wins the contest, "SR" that a rival bidder wins the contest, and "U" that no bidder wins (target is not taken over).

Table 3
Median percentage bid-jumps in multibid contests, 1971-1990

	Sample size	% Offer price revision[a] $(P_O - P_I)/P_O$	% Premium revision[b] $(P_O - P_I)/(P_I - P_{-60})$
I. All multibid contests			
Jump from first to second bid	454	10.00	30.77
Jump from first to final bid	457	14.29	65.08
Average bid-jump througout contest	457	5.43	16.67
II. Contests where second bid is by initial bidder			
Jump from first to second bid	264	7.91	24.40
Jump from first to final bid	264	13.21	35.93
Average bid-jump throughout contest	264	5.00	14.97
III. Contests where second bid is by rival bidder			
Jump from first to second bid	190	13.90	45.20
Jump from first to final bid	193	17.86	59.70
Average bid-jump throughout contest	193	6.67	22.99

[a] P_I is the initial bid price price and P_O is either the second or the final bid price. Thus, this column shows the percent change in the initial bid *price*.

[b] P_{-60} is the no-information target share price 60 days prior to the initial bid. Thus, this column shows the percent change in the initial bid *premium*

Table 4
The Number of Tender Offer Contests Classified by the Toehold of the Initial Bid, Target Management Reaction, and Contest Outcome, 1971-1990.

Reaction and Toehold %	Single Bid Contests S	U	All	Multiple bid contests: 2^{nd} bid by initial bidder S	SR	U	All	2^{nd} bid by rival bidder S	SR	U	All	All Contests
I:Target management supportive												
Initial bidder toehold %												
$0 = x$	119	14	133	6	2	2	10	6	17	5	28	171
$0 < x < 5$	11	0	11	0	0	0	0	2	1	0	3	14
$5 \leq x < 20$	30	3	33	1	0	0	1	0	1	1	2	36
$20 \leq x < 50$	68	10	78	3	0	1	4	0	0	1	1	83
$50 \leq x$	34	5	39	0	0	0	0	0	0	0	0	39
Total	262	32	294	10	2	3	15	8	19	7	34	343
Average %	18.26	21.48	18.61	10.41	0.00	10.33	9.01	0.15	0.89	4.99	1.56	16.50
II: Target management neutral												
Initial bidder toehold %												
$0 = x$	138	55	193	21	7	12	40	7	45	10	62	295
$0 < x < 5$	18	3	21	4	0	4	8	1	4	2	7	36
$5 \leq x < 20$	34	6	40	14	4	5	23	2	9	0	11	74
$20 \leq x < 50$	82	8	90	13	2	2	17	2	5	0	7	114
$50 \leq x$	75	14	89	10	0	0	10	0	0	0	0	99
Total	347	86	433	62	13	23	98	12	63	12	87	618
Average %	22.51	14.31	20.88	19.27	6.21	5.68	14.35	7.65	3.92	0.47	3.96	17.47
III: Target management opposed												
Initial bidder toehold %												
$0 = x$	18	32	50	38	15	19	72	7	27	8	42	164
$0 < x < 5$	5	10	15	22	7	7	36	3	14	0	17	68
$5 \leq x < 20$	13	20	33	30	16	14	60	4	18	4	26	119
$20 \leq x < 50$	9	7	16	7	0	3	10	2	4	2	8	34
$50 \leq x$	3	1	4	2	0	1	3	0	0	0	0	7
Total	48	70	118	99	38	44	181	16	63	14	93	392
Average %	13.64	6.85	9.61	7.10	4.20	6.91	6.44	7.46	5.32	8.41	6.15	7.33
Average %	20.85	13.21	19.43	11.56	4.60	6.58	9.06	5.69	4.11	5.46	4.58	14.57

See Table 1 for sample sources. "S" indicates that the first bidder wins the contest, "SR" that a rival bidder wins the contest, and "U" that no bidder wins (target is not taken over). Target management reaction is based primarily on information in the Street Journal Index, supplemented by 14d filings. The classifications are illustrated as follows: *Supportive:* Target management states that the offer is fair, equitable, or that the bid is friendly. Alternatively, it is announced that the bidder has agreed to acquire the target, possibly following negotiations with target management. *Neutral*: No management reaction is reported in the WSJI, or the report is neutral. *Opposed*: Target management states that the offer is unfair; fraudulent; inadequate; unfriendly; that it is suing or otherwise intending to fight the takeover; or that it has received or been denied an injunction against the bidder.

Table 5
Parameter estimates in a cross-sectional model for the initial bidder's toehold, 1971-1990.
(t-statistics in parentheses)

Constant	*Runup*	*Premium*	*Hostile*	*Iwin*	*Rwin*	*Irevise*	*Onebid*	
I. OLS estimation								
3.81	-11.16	0.01	-4.42	6.00	1.53	-6.00	8.05	R-square
(1.01)	(-2.67)	(1.07)	(-2.76)	(3.21)	(0.48)	(-3.02)	(2.88)	0.11
II. Truncated Tobit estimation								
-20.10	-15.40	0.02	-1.99	11.30	4.10	-8.43	15.3	Log-likelihood
(-2.98)	(-3.58)	(0.82)	(-0.69)	(3.83)	(0.73)	(-2.43)	(2.91)	-1992

Variable definitions:

Toehold: Toehold of initial bidder.

Runup: Target abnormal stock return from day -60 through day -1.

Premium: Initial offer premium relative to target stock price on day -60.

Hostile: Dummy variable with value 1 if target management opposed initial bid and zero otherwise.

Iwin: Dummy variable with value 1 if initial bidder wins the contest,

Rwin: Dummy variable with value 1 if rival bidder wins the contest.

Irevise: Dummy variable with value 1 for single-bidder, multiple-bid contests.

Onebid: Dummy variable with value 1 for single-bid contests.

Table 6
Simultaneous equation (three stage least squares) estimation of a cross-sectional model for the bidder's toehold and the initial offer premium.

Constant	*Runup*	*Markup*	*Multibid*	*Hostile*	*lnTsize*	*Toehold*	*ZeroToe*
Equation 1: Dependent variable: initial bidder's toehold							
β_0	β_1		β_3	β_4	β_5		
18.05	-4.25		-8.72	-5.34	0.08		
(5.4)	(-1.8)		(-6.0)	(-3.6)	(0.3)		
Equation 2: Dependent variable: Initial offer premium							
γ_0		γ_2	γ_3	γ_4		γ_6	γ_7
4.80		0.90	-2.11	-1.33		-0.24	0.01
(1.4)		(4.3)	(-2.8)	(-1.34)		(-2.1)	(0.0)
System $R^2 = 0.58, \chi^2 = 667.14$ with 9 *df*							

Variable definitions:

Toehold: Toehold of initial bidder.

ZeroToe: Dummy variable with value of 1 if toehold equals zero and zero otherwise.

Multibid: Dummy variable with value 1 if multiple-bid contest.

Hostile: Dummy variable with value 1 if target management opposes initial bid.

lnTsize: The log of total market value of target equity measured 60 trading days before the initial bid.

Runup: Abnormal stock return over the 60 days prior to initial bid.

Markup: Abnormal stock return over the 2 days ending with the announcement of the initial bid.

Table 7
Estimated Parameters δ_n^s in a Multinomial Logit Model Determining Tender Offer Outcome-Probabilities p_n^s, from Node s to Node n in the Tender Offer Contest Tree, 1971-1990.
(Asymptotic t-values in parentheses)

Outcome-probabilities		*Constant*	*Premium*	*Toehold*	*Zero-Toe*	*Payment*	*Negotiated*	*Hostile*	**Probability at mean x**[b]
		Explanatory variables in multinomial model[a]							
I: Stage 1 outcome-probabilities from "Initial bid" ($s = 0$)[c]									
p_2^0:	Successful initial bid	.4796 (1.13)	.7710 (2.58)	.0194 (2.95)	.1578 (.59)	-.0122 (-.03)	1.0638 (3.97)		.533
p_3^0:	Second bid by initial bidder	1.5628 (3.55)	.6352 (1.95)	-.0288 (-3.56)	-.8940 (-3.21)	-.3505 (-.89)	-1.2495 (-3.20)		.200
p_4^0:	Second bid by rival bidder	1.2070 (2.60)	.1781 (.51)	-.0490 (-4.24)	-.2903 (-.97)	-.3545 (-.88)	-.0784 (-.24)		.141
	N=1154, Log likelihood=-1270.1, LRT=300.16, df=15								
II: Stage 2 outcome-probabilities from "Initial bidder makes second bid" ($s = 3$)[d]									
p_5^3:	Initial bidder successful	.3286 (.52)	-.0037 (-.01)	.0273 (1.75)	.0267 (.07)	.2450 (.46)	.7465 (.88)	.1002 (.30)	.593
p_6^3:	Rival bidder successful	.5108 (.68)	-.5255 (-1.10)	-.0331 (-1.11)	-.2053 (-.42)	-.5717 (-.99)	.4884 (.45)	.4816 (1.08)	.166
	N=263, Log likelihood=-246.01, LRT=20.75, df=12								
III: Stage 2 outcome-probabilities from "Rival bidder makes second bid" ($s = 4$)[d]									
p_8^4:	Initial bidder successful	-1.1380 (-.93)	.7257 (1.09)	-.0268 (-.58)	.8368 (.82)	.3283 (.39)	-.0863 (-.12)	-.2149 (-.34)	.140
p_9^4:	Rival bidder successful	1.8806 (2.38)	.3526 (.65)	-.0203 (-.85)	-.7933 (-1.21)	.5710 (.87)	-1.5587 (-2.53)	-.3706 (-.75)	.715
	N=191, Log likelihood=-148.86, LRT=22.94, df=12								

The multinomial logit model has the following general form:

$$p_{jn}^s = \exp(\mathbf{x_j}'\delta_n^s) / \sum_{n>s}^{\mathcal{E}^s} \exp(\mathbf{x_j}'\delta_n^s),$$

where there are $K = 7$ bid-specific characteristics in the $(K \times 1)$ vector of determinants $\mathbf{x_j}$, δ_n^s is the (7×1) vector of parameters, and there are a total of $\mathcal{E}^s$ possible events (nodes) conditional on node s. At each stage of the event tree, there are a total of $7\mathcal{E}^s$ different parameters to be estimated.[1] At Stage 1 in the contest tree, there are a total of $\mathcal{E}^0 = 4$ nodes (i.e., nodes 1 - 4). At Stage 2, there are $\mathcal{E}^3 = 3$ nodes (nodes 5 - 7) when one arrives from node 3, and $\mathcal{E}^4 = 3$ nodes (nodes 8 - 10) conditional on arriving from node 4. The sample is restricted to contests with sufficient data to estimate premiums (i.e., targets listed on both NYSE/AMEX and Nasdaq exchanges).

[a] Variable definitions:

Premium = offer price relative to the target's price 60 days before the announcement of the initial offer. In Stage 2 estimates, the premium is the second offer price relative to the target's price 60 days before the initial offer.

Toehold = initial bidder's level of ownership in the target prior to the announcement of the initial offer. In Stage 2 estimates, the toehold is the second bidder's initial level of ownership in the target.

Zero-Toe = dummy variable which equals one if the toehold is zero.

Payment = dummy variable which equals one if the payment method of the initial bid includes securities.

Negotiated = dummy variable which equals one if the initial bidder negotiated a tender precommitment with the target management or a major target shareholder prior to the bid.

Hostile = dummy variable which equals one if the target management opposes the bid.

The Likelihood ratio test (LRT) compares the performance of the model to a model with only constants. The test is distributed as χ^2 with degrees of freedom equal to the number of additional explanatory variables.

[b] This is the probability computed using the mean value of the vector of characteristics $\mathbf{x}$.

[c] Stage 1 probabilities are normalized relative to p_1^0, i.e., the probability of an unsuccessful single-bid contest. The average estimated probability of this node is .1118 with a standard error of .0327. Using the mean value of the vector of characteristics $\mathbf{x}$, the probability is .126.

[d] Stage 2 probabilities are normalized relative to p_7^3 (the probability of no bidder successful conditional on initial bidder making the second bid) and p_{10}^4 (the probability of no bidder successful conditional on rival bidder making the second bid), respectively. The average estimated probabilities are .2357 and .1466, with standard errors of .0481 and .0641. Using the mean value of the vector of characteristics $\mathbf{x}$, these two probabilities are .241 and .145, respectively.

Table 8

Partial Derivatives of the Outcome-Probabilities with respect to the Vector of Offer Characteristics x, evaluated at the Mean of x. (t-values in parentheses)

Outcome-probabilities		Explanatory variables in multinomial model[a] *Constant*	*Premium*	*Toehold*	*Zero-Toe*	*Payment*	*Negotiated*	*Hostile*	Probability at mean x
I: Stage 1 outcome-probabilities from "Initial bid" ($s = 0$)									
p_1^0 :	Unsuccessful single bid	-.0929 (-2.00)	-.0709 (-2.11)	.0003 (.41)	.0171 (.62)	.0159 (.41)	-.0386 (-1.28)		.126
p_2^0 :	Successful single bid	-.1379 (-1.97)	.1108 (2.44)	.0116 (8.49)	.1564 (3.51)	.0610 (1.04)	.4039 (8.28)		.533
p_3^0:	Second bid by initial bidder	.1648 (3.46)	.0144 (.43)	-.0053 (-4.40)	-.1516 (-4.35)	-.0445 (-1.01)	-.3111 (-4.48)		.200
p_4^0:	Second bid by rival bidder	.0660 (1.68)	-.0543 (-1.76)	-.0066 (-3.64)	-.0218 (-.82)	-.3212 (-.99)	-.0542 (-1.81)		.141
II: Stage 2 outcome-probabilities from "Initial bidder makes second bid" ($s = 3$)									
p_5^3:	Initial bidder successful	.0291 (.23)	.0507 (.69)	.0098 (2.77)	.0266 (.35)	.1153 (1.08)	.1321 (.80)	-.0231 (-.33)	.593
p_6^3:	Rival bidder successful	.0383 (.44)	-.0723 (-1.19)	-.0073 (-1.55)	-.0310 (-.52)	-.1031 (-1.50)	-.0059 (-.05)	.0567 (1.02)	.166
p_7^3:	No bidder successful	-.0674 (-.60)	.0215 (.34)	-.0026 (-.87)	.0044 (.07)	-.0122 (-.13)	-.1262 (-.82)	-.0336 (-.57)	.241
III: Stage 2 outcome-probabilities from "Rival bidder makes second bid" ($s = 4$)									
p_8^4:	Initial bidder successful	-.3252 (-1.85)	.0521 (.83)	-.0012 (-.24)	.1801 (1.44)	-.0176 (-.21)	.1456 (1.75)	.0112 (.20)	.140
p_9^4:	Rival bidder successful	.4972 (3.55)	-.0008 (-.01)	-.0015 (-.29)	-.2454 (-2.08)	.0835 (.76)	-.3091 (-2.82)	-.0540 (-.72)	.715
p_{10}^4:	No bidder successful	-.1720 (-1.50)	-.0513 (-.76)	.0027 (.85)	.0653 (.78)	-.0659 (-.81)	.1635 (1.86)	.0428 (.67)	.145

The model for the outcome-probabilities is $p_n^s = \exp(\mathbf{x}'\delta_n^s)/\sum_{n>s}^{\mathcal{E}^s}\exp(\mathbf{x}'\delta_n^s)$, where $\mathbf{x}$ is the K-vector of offer characteristics, δ_n^s is the corresponding K-vector of parameters (reported in Table 7), and $\mathcal{E}^s$ is the total number of possible outcomes following node s. The partial derivatives reported in the table are given by

$$\partial p_n^s/\partial x_k = p_n^s(\delta_{kn}^s - \sum_{e=1}^{\mathcal{E}^s}\delta_{ek}^s p_e^s).$$

[a] Variable definitions:

Premium = offer price relative to the target's price 60 days before the announcement of the initial offer. In Stage 2 estimates, the premium is the second offer price relative to the target's price 60 days before the initial offer.

Toehold = initial bidder's level of ownership in the target prior to the announcement of the initial offer. In Stage 2 estimates, the toehold is the second bidder's initial level of ownership in the target.

Zero-Toe = dummy variable which equals one if the toehold is zero.

Payment = dummy variable which equals one if the payment method of the initial bid includes securities.

Negotiated = dummy variable which equals one if the initial bidder negotiated a tender precommitment with the target management or a major target shareholder prior to the bid.

Hostile = dummy variable which equals one if the target management opposes the bid.

Table 9
Average and Median Cumulative Abnormal Returns to NYSE/AMEX listed Targets, Initial Bidders and Rival Bidders, 1971-1990. (Sample size and Z-value in parentheses).

Period of cumulation (through node s)	Statistic	Average cumulative abnormal return: $\Gamma_s^{-60} = \frac{1}{N}\sum_j^N \Gamma_{js}^{-60}$ Target firms	Initial bidders	Rival bidders
		Stage 1: Initial Bid		
day -60 through	Mean	.3248	.0133	.0216
day of initial bid	Median	.3013	.0068	-.0012
($s = 0$)	(N, Z_s)	(780, 33.39)	(606, 0.98)	(152, 1.35)
		Stage 2: Second Bid in the Contest		
day -60 through	Mean	.4069	.0120	.0611
day of second bid	Median	.3984	.0176	.0602
($s = 3$)[a]	(N, Z_s)	(209, 20.76)	(122, .80)	(42, 2.47)
day -60 through	Mean	.4288	.0297	-.0065
day of second bid	Median	.4226	-.0028	-.0230
($s = 4$)[b]	(N, Z_s)	(142, 17.93)	(92, 1.08)	(110, -.79)
		Stage 3a: Final Contest Outcome, Single-Bid Contests		
day -60 through	Mean	.3200	.0112	-
outcome day, successful	Median	.3070	.0056	-
offers ($s = 2$)	(N, Z_s)	(339, 17.29)	(313, .010)	-
day -60 through	Mean	.1579	-.0076	-
outcome day, unsuccessful	Median	.1407	-.0203	-
offers ($s = 1$)	(N, Z_s)	(88, 4.06)	(79, -.26)	-
		Stage 3b: Final Contest Outcome, Multiple-Bid Contests		
day -60 through	Mean	.4778	.0260	.0314
outcome day, initial bidder	Median	.5162	-.0154	-.0107
successful ($s = 5$ and $s = 8$)	(N, Z_s)	(139, 16.44)	(84, .58)	(22, .72)
day -60 through	Mean	.3791	-.0008	-.0289
outcome day, rival bidder	Median	.4282	-.0064	-.0123
successful ($s = 6$ and $s = 9$)	(N, Z_s)	(151, 13.83)	(87, .28)	(109, .35)
day -60 through	Mean	.2356	.0527	.0406
outcome day, no bidder	Median	.2600	.1083	.0181
successful ($s = 7$ and $s = 10$)	(N, Z_s)	(63, 5.31)	(43, .26)	(21, .86)

Abnormal return for firm j cumulated from day -60 through mode s in the contest tree in Figure 1 is given by $\Gamma_{js}^{-60} = \sum_{w=1}^{s^*} \omega_{jw}\gamma_{jw}$, where s^* is the event window in calendar time that ends with node s in the tree, ω_{jw} is the number of trading days within event window w, and where average daily abnormal returns over each event window

w are estimated directly from the W_j event parameters γ_{jw} in the following market model:

$$r_{jt} = \alpha_j + \beta_j r_{mt} + \beta'_j d_{mt} r_{mt} + \sum_{w=1}^{W_j} \gamma_{jw} d_{jwt} + \epsilon_{jt}.$$

r_{jt} is the continuously compounded rate of return to firm j over day t, r_{mt} is the continuously compounded rate of return on the value weighted market index over day t, d_{mt} is a dummy variable which equals one if day t is greater than or equal to day -60 relative to the announcement of the initial bid in the contest, and zero otherwise, d_{jwt} is one of W_j dummy variables, where each dummy takes on a value of one if day t is within event window w, and zero otherwise, and ϵ_{jt} is an error term, assumed to be normally, identically and independently distributed. See the text for definition of the event windows. The estimation uses ordinary least squares with White's heteroscedastic-consistent covariance matrix. The estimation period starts 191 days prior to the announcement of the initial bid and ends 191 days following the ending date of last bid. Abnormal returns were also estimated using a longer period (-381, 381,) as well as assuming that the residuals follow an autoregressive conditional heteroscedasticity process of order one (ARCH(1)), with qualitatively similar results. The table reports Z-values for the hypothesis that the average cumulative abnormal return Γ from the conditional market model estimation equals zero, where $Z_s = \frac{1}{\sqrt{N}} \sum_{j=1}^{N} \Gamma_{js}^{-60} / \sigma_{\Gamma_{js}}$, which has a standard normal distribution for large sample size N. The variance of Γ_{js}^{-60} is $\sigma^2_{\Gamma_{js}} = \sigma^2 R(X'X)^{-1}R'$, where σ^2 is the regression residual variance, R is a vector in which $R_t = 1$ if any $d_{jnt} = 1$, and X is the matrix of independent variables in the market model.

[a] Second bid by initial bidder.

[b] Second bid by rival bidder.

Table 10
Weighted Least Squares Estimates of Payoffs (μ_n^s) associated with Potential Outcomes in a typical Tender Offer Contests, 1971-1990.

I. Stage 1 estimation from "Initial bid" ($s = 0$)

Dependent variable	Constant[a]	**Log odds regressors** Successful initial bid ($\ln(p_2^0/p_1^0)$)	Second bid by initial bidder ($\ln(p_3^0/p_1^0)$)	Second bid by rival bidder ($\ln(p_4^0/p_1^0)$)
		Targets (N=753, Adjusted R^2=.32)		
Γ_0^{-60}	-.2371	.2877	.1859	.0522
	(-8.85)	(17.69)	(13.74)	(5.39)
Mean log-odds		1.29	.5131	.20
		Initial bidders (N=516, Adjusted R^2=-.002)		
Γ_0^{-60}	-.0194	.0107	.0098	-.0060
	(-.95)	(.98)	(.99)	(-.87)
Mean log-odds		1.60	.3256	.05

II. Stage 2 estimation from "Second bid by initial bidder" ($s = 3$)

Dependent variable	Constant[b]	**Log odds regressors** Initial bidder successful ($\ln(p_5^3/p_7^3)$)	Rival bidder successful ($\ln(p_6^3/p_7^3)$)
		Targets (N=203, Adjusted R^2=.14)	
Γ_3^{-60}	.5133	-.2845	-.2827
	(8.80)	(-3.78)	(-5.83)
Mean log-odds		.86	-.27
		Initial bidders (N=108, Adjusted R^2=.03)	
Γ_3^{-60}	.0047	-.0307	-.0796
	(.11)	(-.55)	(-2.12)
Mean log-odds		.82	-.27

III. Stage 2 estimation from "Second bid by rival bidder" ($s = 4$)

Dependent variable	Constant[c]	**Log odds regressors** Initial bidder successful ($\ln(p_8^4/p_{10}^4)$)	Rival bidder successful ($\ln(p_9^4/p_{10}^4)$)
		Targets (N=137, Adjusted R^2=.29)	
Γ_4^{-60}	.2398	.1832	.0932
	(4.97)	(6.97)	(3.31)
Mean log-odds		-.17	1.58
		Initial bidders (N=77, Adjusted R^2=.01)	
Γ_4^{-60}	.0747	-.0184	-.0448
	(1.65)	(-.68)	(-1.61)
Mean log-odds		.04	1.50

The payoffs μ_n^s are estimated using the following cross-sectional regression equation with log-odds as regressors:

$$\Gamma_{js}^{-60} = \mu_r^s + \sum_{n>s, n\neq n^*}^{\mathcal{E}^s} \mu_n^s \ln(\frac{p_{jn}^s}{p_{jn^*}^s}) + \epsilon_{js} \quad j =, 1.., N,$$

where Γ_{js}^{-60} is the abnormal return to firm j cumulated from day -60 relative to the initial offer date and through node s in the contest tree, $\mathcal{E}^s$ is the number of nodes in the tree following node s, p_{jn}^s is the outcome-probability of node n conditional on node s, n^* is the numeraire (unsuccessful contest) outcome, and ϵ_{js} is an error term. The constant term μ_r^s is the expected payoff to a bid which generates equal outcome-probabilities (and therefore zero log-odds ratios). The dependent variable and the probabilities used to form the log-odds ratios are estimated as in Table 7 and Table 9, and the WLS weights are the standard errors of the estimates of Γ_{js}.

[a] This constant term is the expected payoff to a bid generating $p_1^0 = p_2^0 = p_3^0 = p_4^0 = 1/4$ (and thus zero log-odds).

[b] This constant term is the expected payoff to a bid generating $p_5^3 = p_6^3 = p_7^3 = 1/3$ (and thus zero log-odds).

[c] This constant term is the expected payoff to a bid generating $p_8^4 = p_9^4 = p_{10}^4 = 1/3$ (and thus zero log-odds).

Table 11
Predicted Offer Value ($\hat{\Gamma}(\mathbf{x})$) and its Partial Derivative ($\partial\hat{\Gamma}(\mathbf{x})/\partial x_k$) for Target Firms in Tender Offer Contests, 1971-1990.

Predicted Offer Value ($\hat{\Gamma}(\mathbf{x})$)			Partial derivatives:[a] $\partial\hat{\Gamma}(\mathbf{x})/\partial x_k$					
At reference bid[b]	At mean log-odds[c]	At mean probabilities[d]	*Premium*	*Toehold*	*Zero-Toe*	*Payment*	*Negotiated*	*Hostile*
I: First Bid in Contest ($s = 0$)								
-.2371	.2406	.3430	.3492	-.0023	-.1360	-.0872	.0697	
II: Second Bid in Contest, bid made by initial bidder ($s = 3$)								
.5133	.3434	.3209	.1496	.0016	.0504	.0919	-.3505	-.1647
III: Second Bid in Contest, bid made by rival bidder ($s = 4$)								
.2398	.3558	.4080	.1658	-.0068	.0794	.1134	-.1611	-.0739

The predicted value (abnormal return) of an offer with characteristics $\mathbf{x}$, $\hat{\Gamma}_s(\mathbf{x})$, is computed as

$$\hat{\Gamma}_s(\mathbf{x}) = \hat{\mu}_r^s + \sum_{n \in \mathcal{E}^s, n \neq n^*} \hat{\mu}_n^s \ln\left(\frac{p_n^s(\mathbf{x})}{p_{n^*}^s(\mathbf{x})}\right),$$

where $\hat{\mu}_n^s$ are the payoff estimates from Table 10. There are $K = 7$ bid-specific characteristics in the $(K \times 1)$ vector of determinants $\mathbf{x}$, and there are a total of $\mathcal{E}^s$ possible events (nodes) conditional on node s. The partial derivative of the predicted offer value with respect to the k'th offer parameter, $\partial\hat{\Gamma}_s(\mathbf{x})/\partial x_k$, is given by

$$\partial\hat{\Gamma}_s(\mathbf{x})/\partial x_k = \sum_{n \in \mathcal{E}^s, n \neq n^*} \hat{\mu}_n^s \hat{\delta}_k^s,$$

where $\hat{\delta}_n^s$ is the (7×1) vector of parameter estimates from the multinomial logit model reported in Table 7. This derivative follows since $(p_n^s/p_{n^*}^s) = \exp(\mathbf{x_j}'\delta_n^s)$ and, thus, the log-odds equal $\mathbf{x_j}'\delta_n^s$.

[a] Variable definitions:

Premium = offer price relative to the target's price 60 days before the announcement of the initial offer. In Stage 2 estimates, the premium is the second offer price relative to the target's price 60 days before the initial offer.

Toehold = initial bidder's level of ownership in the target prior to the announcement of the initial offer. In Stage 2 estimates, the toehold is the second bidder's initial level of ownership in the target.

Zero-Toe = dummy variable which equals one if the toehold is zero.

Payment = dummy variable which equals one if the payment method of the initial bid includes securities.

Negotiated = dummy variable which equals one if the initial bidder negotiated a tender precommitment with the target management or a major target shareholder prior to the bid.

Hostile = dummy variable which equals one if the target management opposes the bid.

[b] The value of the reference bid equals the constant term $\hat{\mu}_{r\cdot}^{s}$ and is reproduced here from Table 10. The reference bid represents an offer which produces equal outcome-probabilities across all outcomes in the contest tree and thus zero log-odds.

[c] The estimated value of $\Gamma(\mathbf{x})$ is computed using the mean of log odds observed for that sample (ie. the log odds used to estimate the μ's.

[d] The estimated value of $\Gamma(\mathbf{x})$ is computed using the mean of the probabilities estimated using the full sample of bids.

Figure 1
Sequence of Outcomes and Sample Size (N) in Tender Offer Contest Tree
(There are up to 10 sample bids in a single contest between Stage 2 and Stage 3)