Merger negotiations with stock market feedback*

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Abstract

If you are negotiating a takeover and observe a runup in the target's stock price (the source of which is unknown), do you mark up your planned offer price? We use a rational pricing structure to test this question empirically against the alternative that runups are interpreted by the negotiating parties as market anticipation of the deal. A novel and realistic feature of this pricing structure is to allow takeover rumors to simultaneously increase the bid probability and the expected deal value conditional on a bid. As we show, this implies that a costly feedback loop from runups to offer price markups exists only if the projection of markups on runups is strictly positive. Our large-sample tests reject this implication, but fail to reject the deal anticipation hypothesis for the runup. This conclusion reverses a long-standing claim to the contrary in the takeover literature. We do, however, find evidence of a feedback loop which is *not* costly to bidders and thus does not distort the takeover process: offer premiums are on average marked up by the realized market return over the runup period. Consistent with our pricing structure, the negotiating parties appears to treat this market return as a known change in the target's stand-alone value.

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1 Introduction

There is growing interest in the existence of informational feedback loops in financial markets. By definition, a feedback loop exists if economic agents take corrective actions based on information inferred from security prices.[1] We analyze this phenomenon in the rich context of merger negotiations and takeover bidding. Our setting is one where a bidder is in the process of finalizing merger negotiations, but where the target management demands an increase in the planned offer to reflect a recent runup in the target's stock price. While the true source of the runup is unobservable, the target argues that the runup reflects an increase in its market value as a stand-alone entity (i.e. without a control-change). If the target is correct in this argument, adjusting the already planned offer for the runup is costless to the bidder and therefore justified on economic grounds.

The problem for the bidder is that the runup may also reflect rumor-induced market anticipation of the pending deal, in which case a markup of the bid would mean literally paying twice for the target shares. The risk of paying twice seems substantial as takeover bids are frequently preceded by rumors and media speculations.Also, there is large-sample evidence that target runups tend to be reversed absent a subsequent control change—when all bids fail and the target remains independent (Bradley, Desai, and Kim, 1983; Betton, Eckbo, and Thorburn, 2009). This reversal is inconsistent with runups typically representing increased target stand-alone values. Last, but not least, bidders should be weary of target incentives to overstate the case for offer price markups regardless of the true source of the runup.

In light of these arguments, bidders may refuse to transfer the runup initially, leaving it to potential competition to "prove" that target outside opportunities have increased in value, and walk away if the final premium becomes too high. However, bidders with sufficiently high valuations of the target (to cover the cost of the transfer) may find it in their best interest to yield to target demands and transfer the runup without knowing its true source. We refer to this bargaining outcome as a costly feedback loop as the bidder ends up paying twice. We develop and perform new tests for the existence of this feedback loop within a rational market pricing structure. The alternative is that runups are interpreted by the negotiating parties as rational deal anticipation.

[1] Recently, Bond, Goldstein, and Prescott (2010) develop general equilibrium pricing with stock market feedback loops, while Bakke and Whithed (2010) develop econometric procedures for identifying general price movements of relevance for managerial investment decisions.

Our market pricing structure allows us to derive and test hitherto overlooked implications of rational deal anticipation. The structure reveals the functional form of the relationship between target stock price runups and subsequent offer price markups (offer price minus runup), as well as between target runups and bidder takeover gains. We use this structure to answer questions like: What are testable implications for the projection of markups on runups in the presence of a costly feedback loop? How does this projection change when the runup reflects a known target stand-alone value change? What does the pricing structure imply for the relationship between target runups and *bidder* takeover gains?

An important feature of our rational pricing structure is to allow takeover rumors to simultaneously increase the bid probability and the expected deal value conditional on a bid. This generalization leads to fundamentally different predictions and empirical conclusions relative to earlier studies. Schwert (1996), the first to address the issue of costly markup pricing, argues intuitively that if target runups are driven by deal anticipation, the slope coefficient in linear regressions of offer price markups on runups should equal -1 (runups substitute for markups as offer premiums do not respond to runups). Conversely, he predicts a slope coefficient of zero if the runup is transferred dollar for dollar to the target in the form of a higher premium ("markup pricing"—the markup is independent of the runup). His linear regression results reject a slope coefficient of -1 but fails to reject a coefficient of zero, and he concludes that markup pricing exists and that target runups are costly for bidders.[2]

Again, while a bargaining outcome where the bidder yields to target demands and raises the offer price with the runup is feasible, common sense suggests it should not be a *dominant* outcome in the data. Schwert's conclusion raise concerns that runups distort the efficiency of the takeover mechanism itself. We resolve this important puzzle on several fronts. We begin by showing that linear projections of markups or offer premiums on runups have virtually no power to reject pricing effects of deal anticipation. In general, rational deal anticipation implies a strict nonlinear form for the relationship between runups and offer price markups.

This nonlinearity turns out to be important empirically. With a sample of 6,100 initial takeover bids from the period 1980 through 2008, we demonstrate that the predicted nonlinear fit under

[2] "The evidence...suggests that, all else equal, the [pre-bid target stock price] runup is an added cost to the bidder." (Schwert, 1996, p.190).

rational deal anticipation is statistically superior to a linear projection. While the data rejects linearity, it also shows that the form of the nonlinearity is remarkably close to the theoretical form generated using a normal distribution for the synergy signal under deal anticipation. This conclusion holds for several alternative definitions of markup and runup, and it is robust to a number of controls for bidder-, target- and deal characteristics.

We then turn to the possible existence of a costly feedback loop in the data. We begin by proving formally that, with rational bidding, a costly feedback loop implies that the projection of markups on runups should yield a *positive* slope—not zero as previously thought. The intuition here is that, with rational bidding, a forced transfer of the runup to the target increases the rational minimum bid threshold, resulting in observed bids having greater expected synergies. Moreover, as this positive effect on expected synergies increases as the synergy signal in the runup period improves, the projection of the offer price markup on the runup is positive.

In our data, however, the projection of the markup on the runup produces a significantly negative slope. This finding rejects the costly feedback loop hypothesis but does not reject deal anticipation. Whatever runup has happened over the two months prior to observed bids does not seem to be misinterpreted by the negotiating parties as a stand-alone value change when it is caused by deal anticipation. We therefore conclude that target runups do not appear to distort the bidding process *ex post*.[3]

There *does* appear to exist a feedback loop from target runups—but with no potential for distorting bid incentives: We find that offer prices are almost perfectly correlated with the market return over the runup period. Since the market return is exogenous to the merger synergies, the market-driven portion of the target runup presents the negotiating parties with *prima facie* evidence of a change in the target's stand-alone value. As such it may be transferred to the target shareholders at no cost to the bidder, which appears to be the preferred bargaining outcome in practice.

We also develop and test new and interesting implications of the deal anticipation hypothesis

[3]Events which cause stock price runups of potential target firms *ex ante* (before the takeover process have begun) may still deter some bids. For example, if the source of bidder gains is target undervaluation, exogenous events which correct market underpricing will reduce the incentive to identify undervalued firms (Jarrell and Bradley, 1980; Bradley, Desai, and Kim, 1983; Edmans, Goldstein, and Jiang, 2011). In our setting with bargaining over bidder-specific synergy gains, runups caused by market corrections of target mispricing represent changes in target stand-alone values and thus do not deter bids.

for bidder takeover gains. Just as rational deal anticipation constrains the relation between target runups and offer price markups, it also constrains the relation between target runups and bidder returns. Simply put, stronger synergy signals create greater runups and greater conditional expected takeover gains to *both* merger partners. Under deal anticipation, bidder takeover gains must therefore be increasing in the *target* runup. This implication receives surprisingly strong empirical support.

The statistically significant positive relation between bidder gains and target runups is jointly consistent with rational bidding and the deal anticipation hypothesis for the runup. It also confirms that the target runup is a proxy for *total* expected synergies in takeover and not just for the portion accruing to target shareholders. As such, the target runup constitutes a useful empirical control in cross-sectional examinations of the determinants of merger synergies.

The rest of the paper is organized as follows. Section 2 lays out the dynamics of runups and markups as a function of the information arrival process surrounding takeover events, and it discusses predictions of the deal anticipation hypothesis. Section 3 performs our empirical analysis of the projections of markups on runups based on the theoretical structure from Section 2. Section 4 shifts the focus to the relationship between target runups and bidder takeover gains, developing both theory and tests. Section 5 concludes the paper.

2 Pricing implications of rational deal anticipation

This section analyzes the information arrival process around takeovers, and how the information in principle affects offer prices and, possibly, feeds back into offer price corrections. It is instructive to begin by providing a sense of the economic importance of the target runup in our data. Figure 1 illustrates the takeover process which begins with the market receiving a rumor of a pending takeover bid, resulting in a runup V_R of the target stock price. In our vernacular, V_R is the market feedback to the negotiating parties prior to finalizing the offer price. Since the exact date of the rumor is largely unobservable, V_R is measured over a *runup period* which we in our empirical analysis take to be the two calendar months prior to the first public bid announcement. Figure 1 shows an average abnormal (market risk adjusted) target stock return of about 10% when cumulated from day -42 through day -2.[4]

In the theory below, we define the expected offer price markup as $V_P - V_R$, where V_P denotes the expected final offer premium. In Figure 1, this is shown as the target revaluation over the three-day announcement period (day -1 through day +1). The initial offer announcement does not fully resolve all uncertainty about the outcome of the takeover (it may be followed by a competing offer or otherwise rejected by target shareholders), and so V_P is the expected final offer premium conditional on a bid having been made. The average three-day target announcement return is about 25% in the full sample of takeovers.

The challenge for the negotiating parties is to interpret the information in this runup: does it justify correcting (marking up) the already planned bid? In some cases, the runup may reflect a known change in stand-alone value which naturally flows through to the target in the form of a higher offer premium. In other cases, the target management may have succeeded in arguing that the runup is driven by stand-alone value changes when it is not (and so feeding the runup back into the offer price amounts to "paying twice"). The point of our analysis is not to rationalize a specific bargaining outcome but to derive testable implications for the relationship between runups, markups, and bidder returns.

We begin by analyzing the case where the negotiating parties agree that the target runup is driven by deal anticipation only. This is followed by the presence of a known target stand-alone value change in the runup period. Finally, the analysis covers the feedback hypothesis where the offer price is marked up with the target runup even in the absence of a target stand-alone value change.

2.1 Projections of markups on runups

Suppose the market receives a signal s which partially reveals the potential for synergy gains S from a takeover. S is known to the bidder and the target, while the market only knows the distribution over S given the signal. The bid process involves a known (negotiated) sharing rule $\theta \in [0, 1]$ for how the synergy gains will be split between target and bidder, and a negotiated sharing rule $\gamma \in [0, 1]$ for the bidding cost C, both of which are also known to all. [5] Let $K = \frac{\gamma C}{\theta}$ denote the

[4] Our sample selection procedure is explained in section 3.2 below.

[5] The cost C include things like advisory fees, litigation risk and the opportunity cost of expected synergy gains from a better business combination than the target under consideration. The question of whether or not bids to

threshold in S above which the benefit to the bidder of making an offer is positive. $B(S,C)$ denotes the benefit to the target of the takeover, i.e., its portion of the total synergy gains S net of the target's portion of the bidding cost C. We assume that $B(S,C) = 0$ if no bid takes place, which occurs when $S < K$.[6]

For simplicity, the target's stock price and the market's takeover probability $\pi(s)$ are both normalized to zero prior to receiving takeover rumors s. The signal s causes the market to form a posterior distribution over synergy gains S and to update the takeover probability $\pi(s)$ accordingly. Both effects contribute to a revaluation of the market price of the target. The revaluation (runup) equals the expected value of the bid conditional on s:

$$V_R = \pi(s)E_s[B(S,C)|s, bid] = \int_K^\infty B(S,C)g(S|s)dS, \tag{1}$$

where $g(S|s)$ is the market's posterior density of S given s.

At the moment of the first bid announcement, but not necessarily knowing precisely what the final bid will be (or whether it will be accepted by the target shareholders), the expected final bid premium is

$$V_P = E_s[B(S,C)|s, bid] = \frac{1}{\pi(s)} \int_K^\infty B(S,C)g(S|s)dS. \tag{2}$$

V_P is the expected portion of the (net) synergy gains accruing to the target, given the signal s and the fact that a bid occurs. The observed, initial bid premium should equal V_P plus random variation (uncorrelated noise) due to the remaining uncertainty about the synergies accruing to the target.[7]

targets are set so that targets share in the cost of extending bids is an interesting empirical question. Throughout the paper, we assume a benefit function for bidders and targets which allow bidders and targets to share the bidding costs.

[6]This assumption is motivated by the empirical takeover literature which shows that the target stock price on average returns to its pre-runup stand-alone level when no bidder wins and the target remains independent (Bradley, Desai, and Kim, 1983; Betton, Eckbo, and Thorburn, 2009). The assumption is that any synergy gains are lost if a bid is not made and costs are not incurred absent a bid. One can imagine multi-period extensions wherein future bidders might move, with some probability, to reap potential synergy gains signaled through s if the current bidder withdraws. The runup would then countenance these benefits with associated probabilities, while the market reaction to an initial bid would also be relative to expectations about future prospects.

[7]This abstracts from uncertainty about the success of an initial offer or a potential change in terms leading into a final bid, e.g. driven by competing bidders or target resistance. This uncertainty tends to attenuate the market reaction to the initial bid announcement (shown in Figure 1). The uncertainty increases with the wait time from the initial bid to the final target shareholder vote, which averages several months in the data (Betton, Eckbo, and Thorburn, 2008a). During this wait period, the target board has a fiduciary responsibility (at least when incorporated in the state of Delaware) to accept the highest bid, even if it has already signed a merger agreement (the standard agreement contains a so-called "fiduciary out" clause to regulate potential competing bids). We return to the issue

The expected markup, $V_P - V_R$, is the remaining surprise that a bid takes place times the expected value of the bid and, when combined with equation (1), can be written as

$$V_P - V_R = \frac{1-\pi(s)}{\pi(s)} V_R. \quad (3)$$

Equation (3) is an implication of market rationality, and we use this equation to study empirically the behavior of the intercept and the slope coefficient in cross-sectional projections of the markup on the runup under deal anticipation. Proposition 1 summarizes key properties of this projection:

Proposition 1 (deal anticipation): *With deal anticipation, the projection of $V_P - V_R$ on V_R is nonlinear in the signal s. Moreover, the degree of non-linearity depends on the sharing of synergy gains, net of bidding costs, between the bidder and the target.*

Proof: We show the proof for the case where the distribution of s around S is such that the posterior distribution of S given s is uniform: $S|s \sim U(s-\Delta,\ s+\Delta)$. The valuation equations for the target are, respectively:[8]

$$V_P = \frac{1}{2}[(1-\theta)(s+\Delta) - (1-\gamma)C] \quad \text{and} \quad V_R = \frac{s+\Delta-\frac{\gamma C}{\theta}}{2\Delta} V_P. \quad (4)$$

of ultimate target success probability in the empirical analysis below, where we perform various robustness checks on the specification of V_P in Eq. (2).

[8]With the uniform distribution, the density $g(S|s)$ is a constant, $g(S|s) = \frac{1}{s+\Delta-(s-\Delta)} = \frac{1}{2\Delta}$. Moreover, the takeover probability $\pi(s) = Prob[s \geq K] = \frac{s+\Delta-K}{2\Delta}$. Since the actual bid is $B(S,C) = (1-\theta)S - (1-\gamma)C$, the expected bid is

$$\begin{aligned}
V_P &= \frac{1}{\pi(s)} \int_K^{s+\Delta} B(S,C) g(S|s) dS \\
&= \frac{2\Delta}{s+\Delta-K} \int_K^{s+\Delta} [(1-\theta)S - (1-\gamma)C] \frac{1}{2\Delta} dS \\
&= \frac{1}{s+\Delta-K} \left\{ \frac{(1-\theta)S^2}{2} - (1-\gamma)CS \right\}_K^{s+\Delta} \\
&= \frac{1}{s+\Delta-K} \left\{ \frac{1-\theta}{2}[s+\Delta-K][s+\Delta+K] - (1-\gamma)C[s+\Delta-K] \right\} \\
&= \frac{1-\theta}{2}(s+\Delta+K) - (1-\gamma)C.
\end{aligned}$$

Noting that $K = \frac{\gamma C}{\theta}$ yields the expression for V_P in equation (4). Moreover, the expression for V_R is $V_R = \pi(s) V_P$.

The first derivatives with respect to s are

$$\frac{\partial V_P}{\partial s} = \frac{1-\theta}{2} \quad \text{and} \quad \frac{\partial V_R}{\partial s} = \frac{(1-\theta)(s+\Delta)-(1-\gamma)C}{2\Delta}. \tag{5}$$

Over the range where the bid is uncertain (when some values of S given s are below K), the ratio of the derivative of the expected markup divided by the derivative of the runup is

$$\frac{\partial[V_P - V_R]}{\partial V_R} = \frac{-(1-\theta)s+(1-\gamma)C}{(1-\theta)(s+\Delta)-(1-\gamma)C}. \tag{6}$$

Since the ratio in equation (6) is a function of s, the relation between expected markup and runup does not have a constant slope (nonlinearity). Moreover, the ratio also contains the parameters θ, γ and C, all of which determine the sharing of synergies net of bidding costs. ■

Figure 2 illustrates the relation between V_P, $V_P - V_R$ and V_R for the uniform case (Panel A) and the normal case (Panel B), assuming $\theta = 0.5$, $\gamma = 1$, and that the bid costs C are low relative to the uncertainty Δ in S. The horizontal axis is the synergy signal s which drives the conditional bid probability $\pi(s)$ and the target runup. The runup function has several features. First, at very low bid probabilities, the runup is near zero, but, if a bid takes place, the markup has a positive intercept. This is because when the bidder is just indifferent to a bid ($\theta S = \gamma C$), the target still receives a positive net benefit. Second, as the bid probability increases, the runup increases in a convex fashion as it approaches V_P. Both the deal probability and the conditional expected bid premium are moving in the same direction with s.

Turning to the expected markup, $V_P - V_R$, when the bid probability moves above zero on the low range of s, the impact of s is initially positive because the negative impact on the surprise that a bid takes place is less important than the improvement in expected bid quality S. However, after a point, the expected markup begins to fall as the surprise declines faster than expected deal quality improves. At extremely high s, the bid is almost perfectly anticipated and the expected markup approaches zero. With the uniform distribution in Panel A, there is a point in s above which the bid is certain to take place ($\pi(s) = 1$) because the entire range of S given s is above $K = \frac{\gamma C}{\theta}$. Above this point the expected markup inflects and becomes zero. With the normal distribution in Panel B, the bid probability never reaches one.

Figure 3 shows the functional form of the projection of the markup on the runup using the assumptions of 2. That is, Figure 3 transforms the x axis from s in Figure 2 to the runup V_R.[9] In Panel A, the uncertainty in the synergy S given s has a uniform distribution, while in Panel B, it is distributed normal with the same standard deviation ($\Delta/\sqrt{3} = 1.73$).

Several aspects of the relations now show clearly. First, the relation between the runup and the expected markup is generally non-monotonic. The ratio of derivatives shows that the sharing rule as well as the relation between bid costs and uncertainty about the synergy gains influence the slope of the function, creating a concave projection of $V_P - V_R$ onto V_R. Comparing panels A and B, Figure 3 also shows that the shape of the projection changes only slightly when one goes from a uniform to a normal distribution: the only notable difference is that the right tail of the projection of the markup on the runup has a gradual inflection that creates a convexity for highly probable deals even before these deals are certain to take place. While the right tail then progresses towards zero, no deal is certain with a normally distributed posterior.

Armed with the benefit function, and cost magnitude relative to the uncertainty in S, it is possible to create a range of relations between expected markup and runup (not shown in the figure). If, for example, the sharing of synergy gains and costs are equal ($\theta = \gamma$), the expected markup starts at zero and proceeds through a concave curve back to zero, both when shown against the synergy signal s and the runup. On the other hand, if the uncertainty in S is relatively low in comparison to bid costs ($\Delta < C$), and the bidder bears all of the costs ($\gamma = 1$), the expected markup can start at a high intercept and progress negatively to zero.

Schwert (1996) argues that a linear projection of markups on runups should produce a coefficient of minus one under deal anticipation (as the runup substitutes for the markup dollar for dollar). However, this argument ignores the joint impact of the signal s on the takeover probability and the expected synergies in the deal (Proposition 1). As summarized in Lemma 1, under the deal anticipation hypothesis, the slope coefficient in a linear projection in fact has a much wider range than conventionally thought:

Lemma 1 (linear projection): *With deal anticipation, and as long as the takeover probability* π

[9] The transformation is possible because V_R is monotonic in s and thus has an inverse. To achieve the projection, the inverse function ($V_P(s)^{-1}$) is inserted into $V_P - V_R$ on the vertical axis.

is a function of the synergy gains S, a linear projection of $V_P - V_R$ on V_R yields a slope coefficient that is strictly greater than -1, and the coefficient need not be different from zero.

Proof: For the first part of the lemma, it suffices to show that the maximum negative slope in the projection of the expected markup on the runup is greater than -1. Differentiation of equation (6) shows that the slope becomes more negative as s increases. The most negative slope is at the maximum s that still causes uncertainty in the bid. This point is reached when $s = (\gamma/\theta)C + \Delta$. Substitution into the ratio $(V_P - V_R)/V_R$ yields $-A/[A + (1-\theta)\Delta]$, where $A = (1-\theta)\Delta + (\gamma/\theta)C$. Since $A \geq 0$, this ratio must be greater than -1. For the second part of the lemma, note that equation (6) equals zero at the point where $s = (1-\gamma)/(1-\theta)C$. Such a point is viable whenever $(1-\gamma)/(1-\theta)C + \Delta \geq \gamma C/\theta$, and $0 < \theta < 1$. There always exists a Δ for which this is true. ■

Because the coefficient $\frac{1-\pi(s)}{\pi(s)}$ in equation (3) is nonnegative, finding a negative linear slope immediately rejects linearity but *not* deal anticipation (Proposition 1).[10] Also, because $V_P = \frac{1}{\pi(s)} V_R$, if one switches the dependent variable from the markup to the offer premium in the projection on runup, one must change the form of the right-hand side accordingly. Thus, the argument in the extant literature that the slope in a linear projection of the premium on the runup will have a coefficient of zero under deal anticipation (to capture the intuition that the offer premium does not respond to the runup) is incorrect because it does not account for the impact of the cross-sectional variation in the offer probability $\pi(s)$.

2.2 Adding a stand-alone value change to the target runup

The model in equation (1) abstracts from information which causes revisions in the target's stand-alone value during the runup period. Let T denote this stand-alone value change and assume that T is exogenous to the pending takeover and that it does not impact the bidder's estimate of the synergy gains S (which is driving the takeover process). As a result, T does not affect the probability of a bid.[11] Moreover, whatever the source of T, assume in this section that both the

[10] The projection is linear only if the slope coefficient $\frac{1-\pi(s)}{\pi(s)}$ is cross-sectionally constant. Even if that were true (a near-impossibility in of itself), this constant cannot be negative.

[11] The cost of extending a bid might be related to the target size so changes in stand-alone value might impact C and therefore $\pi(s)$ indirectly. We do not consider this issue here.

bidder and the target agree on its value.[12] This means that the negotiating parties will allow the full value of T to flow through to the target through a markup of the offer price.

Since T accrues to the target whether or not it receives a bid, if a bid is made, the bid premium will be $B(S,C)+T$ and the runup becomes

$$V_{RT} = \pi(s)E_s[B(S,C)+T|s, bid] + [1-\pi(s)]T = V_R + T. \tag{7}$$

Subtracting T on both sides yields the *net runup*, $V_{RT}-T$, which is the portion of the runup related to takeover synergies only. Once a bid is made, it is marked up by the stand-alone value increase:

$$V_{PT} = E_s[B(S,C)+T|s, bid] = V_P + T, \tag{8}$$

where the portion $V_{PT}-T$ of the bid again relates to the synergy gains only.

Moreover, since both V_{RT} and V_{PT} include T, the effect of T nets out in the markup $V_{PT}-V_{RT}$ which remains unchanged from section 2.1. However, the projection now uses the net runup on the right-hand side:

$$V_{PT} - V_{RT} = \frac{1-\pi(s)}{\pi(s)}[V_{RT}-T], \tag{9}$$

which also contains the nonlinearity. Eq. (9) implies that if the markup is projected on V_{RT} with no adjustment for T, the variation in runups across a sample due to changes in stand-alone values will appear as noise unrelated to the markup. The effect is to attenuate the nonlinear impact of the synergy signal s on the relation between the runup and the markup:

Proposition 2 (stand-alone value change): *Adding a known stand-alone value change T to the target runup, where T is independent of S, lowers the slope coefficient in a projection of markup on net runup towards zero. A slope coefficient less than zero, or the projection being nonlinear, implies that a portion of the runup is driven by deal anticipation and substituting for the markup.*

[12]The agreement may be viewed as a bargaining outcome after the target has made its case for marking up the premium with its own estimate of T. Given the target's incentives to overstate the case for T, the bargaining outcome may well be tied to certain observable factors such as market- and industry-wide factors, which the bidder may find acceptable. We present some evidence consistent with this below.

Proof: We again illustrate the proof for the uniform case. The valuation equations for the target are now:

$$V_{PT} = \frac{1-\theta}{2}(s+\Delta+\frac{\gamma C}{\theta}) - (1-\gamma)C + T \quad \text{and} \quad V_{RT} = \frac{s+\Delta-\frac{\gamma C}{\theta}}{2\Delta}V_P, \tag{10}$$

where V_P as before is the expected bid premium with zero change in the target's stand-alone value (as in eq. (2)). Using these valuation equations, Figure 4 illustrates how a sample of data might look if it contains independent variation in both s and T. Behind Figure 4 is a set of six subsamples of data, each subsample containing a different T. Within each subsample, the data contains observations covering continuous variation in s. Across subsamples, the expected markup function shifts right as T increases. The dotted and dashed lines show the relation between expected markup and runup when T is zero and at its maximum across subsamples. The solid line shows the vertical average across the six subsamples for each feasible V_{RT}. The addition of variation in T moderates the relation observed in any subsample that holds T constant. However, there is still a concavity in the relation between average markup $V_P - V_R$ and V_{RT}.[13] ■

Rearranging eq. (9) provides a link to earlier work such as Schwert (1996) who regresses the offer premium on the runup:

$$V_{PT} = \frac{1}{\pi(s)}[V_{RT} - T] + T. \tag{11}$$

Therefore, in a rational market with both deal anticipation and a known change in stand-alone value, the offer premium should relate in a non-linear way to the net runup and one-for-one with surrogates for changes in stand-alone value. Moreover, the net runup should be unrelated to surrogates for changes in stand-alone value, so the one-for-one relation between premiums and surrogates for T holds in a univariate regression setting.

2.3 Costly feedback loop: Transferring the runup to the target

We now examine the case where bids are corrected for the full target runup V_R even in the absence of a change in the target's stand-alone value. Marking up the offer price when the runup is caused by deal anticipation amounts to a wealth transfer from the bidder to the target. A decision by

[13]For a benefit function that has the bidder paying all of the bid costs, the relation is monotonic downward sloping, although with an attenuated slope.

the bidder to mark up the planned offer with V_R may be the outcome of a bargaining process where neither party knows how to interpret the runup, or where the target management succeeds in convincing the bidder that the runup is driven by stand-alone value changes. The point here is not to rationalize such an outcome in detail, but to derive the implied pricing relationship between markups and runups if the outcome exists.

As argued in the following proposition, given rational bidding, adding a costly feedback loop implies that the projection of the offer price markup on the target runup will have a strictly *positive* slope. Intuitively, a forced transfer of the runup to the target increases the minimum bid threshold K (the minimum synergy gains to cover bidding costs) and, as a consequence, observed bids will have greater total synergies. Moreover, this positive effect on total synergies in observed bids increases with the runup transfer. The hypothesis that the full runup is transferred to the target is therefore rejected by a negative slope in the projection of markups on runups:

Proposition 3 (costly feedback loop): *When runups caused by deal anticipation are transferred from bidders to targets through a higher offer premium (so the bidder pays twice), the markup is a positive and monotonic function of the runup.*

Proof: We use superscript * to denote the case where the bidder transfers the runup to the target. The proof has two steps. We first demonstrate that $\partial V_R^*/\partial s > 0$. Second, we show that the markup $V_P^* - V_R^*$ is positive and monotone in V_R^*. Our only assumptions are rational bidding, a benefit function B which is increasing in S, and a conditional pdf of S such that $E(S)$ is increasing in s. The runup is now

$$\begin{aligned} V_R^* &= \pi^*(s)\{E_s[B(S,C)|s,bid] + V_R^*\} \\ &= \int_{K^*}^{\infty} [B(S,C) + V_R^*] g(S|s) dS \\ &= \frac{\pi^*}{1-\pi^*} E_s[B(S,C)|s,bid], \end{aligned} \tag{12}$$

where K^* is the is the new rational bidding threshold which is increasing in V_R^*. The derivative is

$$\frac{\partial V_R^*}{\partial s} = \frac{E(B)}{(1-\pi^*)^2}\frac{\partial \pi^*}{\partial s} + \frac{\pi^*}{1-\pi^*}\frac{\partial E(B)}{\partial s}. \tag{13}$$

Since the second term in (13) is positive by assumption, $\partial V_R^*/\partial s > 0$ if $\partial \pi^*/\partial s > 0$. Using Leibnitz rule,

$$\frac{\partial \pi^*}{\partial s} = \int_{K^*}^{\infty} g'(S|s)dS - g(K^*)\frac{\partial K^*}{\partial s}. \tag{14}$$

Since the first term in (14) cannot be negative, $\partial \pi^*/\partial s > 0$ if $\partial K^*/\partial s > 0$ and the second term is smaller than the first term. Rational bidding implies that $\partial K^*/\partial s$ has the same sign as $\partial V_R^*/\partial s$.[14] This implication is violated if $\partial V_R^*/\partial s < 0$: For $\partial V_R^*/\partial s$ to be negative, $\partial \pi^*/\partial s$ must also be negative, which means that the second term in (14) must be large enough to outweigh the first term. But this requires $\partial K^*/\partial s > 0$, which contradicts rational bidding when $\partial V_R^*/\partial s < 0$. With $\partial V_R^*/\partial s > 0$ there is no contradiction.[15] The proof is complete when we also show that $\partial(V_P^* - V_R^*)/\partial s > 0$. For this we use Eq. (3), which as a general implication of market rationality must also hold for the case with a runup transfer. Substituting Eq. (12) into Eq. (3) yields

$$V_P^* - V_R^* = E_s[B(S,C)|s, bid], \tag{15}$$

which is increasing in s. ■

Proposition 3 is illustrated in Figure 5 for the uniform case, with $\theta = 0.5$ and $\gamma = 1$ (as before in Figure 2A), and $K^* == \frac{\gamma C + V_R^*}{\theta}$. Bidding cost are $C = 1$ and the uncertainty in the synergy S is $\Delta = 4$.[16] Panel A shows the valuations as well as the deal probability π^* as a function of the signal s. Panel B shows the markup projection. Since the deal probability is now a decreasing function of the runup, it is lower for any signal s relative to the earlier model in Eq. (3) without a runup transfer. Moreover, π^* remains strictly less than one for all signals because it remains uncertain whether bidders will meet the minimum bid threshold K^* even when the synergy signal s is large.[17]

[14] It measures the change in the lower limit on benefits caused by an increase in the runup transfer V_R^*. If s increases V_R, it must also increase K^*.

[15] $\partial V_R^*/\partial s > 0$ when $\partial \pi^*/\partial s > 0$, $\partial K^*/\partial s > 0$, and the second term in (14) is smaller than the first term.

[16] Any stand-alone value change T are ignored in this example without loss of generality.

[17] In our example, π^* converges to 0.5 (the value of θ). Reflecting the elimination of marginal bids as the runup is transferred to the target, at the point where the takeover probability $\pi = 1$ in Figure 2A (without a transfer of the runup), the takeover probability in Figure 5A is only $\pi^* = 0.37$.

As a result, the markup continues to capture a surprise element and is increasing in both the signal and in the endogenous runup. This effect is clearly shown in Figure 5B.

3 Empirical projections of markups on runups

3.1 Summary of empirical hypotheses and test strategy

We focus on tests of three empirical hypotheses based directly on the theory in Section 2. For expositional purposes, we begin with the issue of flow-through of a known target stand-alone value change T (Proposition 2) because this proposition can be tested using a standard linear regression format. We then proceed to test the predicted nonlinearity of the relationship between markups and runups under rational deal anticipation (Proposition 1), followed by tests for the existence of a costly feedback loop (Proposition 3).

Note that the three hypotheses stated below also include implications of deal anticipation for *bidder* takeover gains, which are developed and tested in Section 4, below.

H1 **Stand-alone value adjustment:** *Offer prices are marked up by the market return.*

The market return over the runup period produces a change in the target's stand-alone value which the negotiating parties agree should flow through to the target in the form of a higher offer premium (Eq. 11 and Proposition 2). Because the market return is independent of the merger synergy gains, H1 is tested using a linear (multivariate) regression of the initial offer premium on the market return over the runup period.

H2 **Deal anticipation in the runup:** *Offer price markups are nonlinear in net target runups.*

When runups reflect deal anticipation, projections of the markups on net runups have a specific non-linear shape (equations 3 and 9, and Proposition 1). The slope coefficient in this projection ranges anywhere between positive and negative depending on the sample-specific frequency distribution of the synergy signal rumored in the runup period. H2 is tested by contrasting the statistical fit of nonlinear v. linear specifications of markup projections. Deal anticipation also implies that *bidder* takeover gains are increasing in *target* runups (Proposition 4, Section 4 below).

H3 **Costly feedback loop:** *Runups reflecting deal anticipation are transferred to the target.*

When runups caused by deal anticipation are transferred to the target (so the bidder pays twice), the projection of markups on runups yields a slope that is positive everywhere (Proposition 3). H3 is tested using the sign of the slope coefficient in projections of markups on runups.

3.2 Sampling procedure and descriptive statistics

3.2.1 Initial bids, runups and offer premiums

As summarized in Table 1, we sample control bids from SDC using transaction form "merger" or "acquisition of majority interest", requiring the target to be publicly traded and U.S. domiciled. The sample period is 1/1980-12/2008. In a control bid, the buyer owns less than 50% of the target shares prior to the bid and seeks to own at least 50% of the target equity.

The bids are grouped into takeover contests. A takeover contest may have multiple bidders, several bid revisions by a single bidder or a single control bid. The initial control bid is the first control bid for the target in six month. All control bids announced within six months of an earlier control bid belong to the same contest. The contest ends when there are no new control bids for the target over a six-month period. This definition results in 13,893 takeover contests. We then require targets to (1) be listed on NYSE, AMEX, or NASDAQ; and have (2) at least 100 days of common stock return data in CRSP over the estimation period (day -297 through day -43);(3) a total market equity capitalization exceeding $10 million on day -42; (4) a stock price exceeding $1 on day -42; (5) an offer price in SDC; (6) a stock price in CRSP on day -2; (7) an announcement return for the window [-1,+1]; (8) information on the outcome and ending date of the contest; and (9) a contest length no longer than 252 trading days (one year). The final sample has 6,150 control contests.

Approximately three-quarters of the control bids are merger offers and 10% are followed by a bid revision or competing offer from a rival bidder. The frequency of tender offers and multiple-bid contests is higher in the first half of the sample period. The initial bidder wins control of the target in two-thirds of the contests, with a higher success probability towards the end of the sample period. One-fifth of the control bids are horizontal. A bid is horizontal if the target and acquirer has the same 4-digit SIC code in CRSP or, when the acquirer is private, the same 4-digit SIC code in SDC.[18]

Table 2 shows average premiums, markups, and runups, both annually and for the total sample. The initial offer premium is $\frac{OP}{P_{-42}} - 1$, where OP is the initial offer price and P_{-42} is the target stock closing price or, if missing, the bid/ask average on day -42, adjusted for splits and dividends. The bid is announced on day 0. Offer prices are from SDC. The offer premium averages 45% for the total sample, with a median of 38%. Offer premiums were highest in the 1980s when the frequency of tender offers and hostile bids was also greater, and lowest after 2003. The next two columns show the initial offer markup, $\frac{OP}{P_{-2}} - 1$, which is the ratio of the offer price to the target stock price on day -2. The markup is 33% for the average control bid (median 27%).

The target runup, defined as $\frac{P_{-2}}{P_{-42}} - 1$, averages 10% for the total sample (median 7%), which is roughly one quarter of the offer premium. While not shown in the table, average runups vary considerably across offer categories, with the highest runup for tender offers and the lowest in bids that subsequently fail. The latter is interesting because it indicates that runups reflect the probability of bid success, as expected under the deal anticipation hypothesis. The last two columns of Table 2 show the net runup, defined as the runup net of the average market runup ($\frac{M_{-2}}{M_{-42}} - 1$, where M is the value of the equal-weighted market portfolio). The net runup is 8% on average, with a median of 5%.

3.2.2 Block trades (toehold purchases) in the runup period

We collect block trades in the target during the runup period, which we label "short-term toeholds", and record whether the block is purchased by the bidder or some other investor. This data is interesting in our context for two reasons. First, target block trades may cause takeover rumors and therefore directly impact the runup. Thus, these transactions allow one to check whether events such as open-market trades—which we show below lead to greater runups—also raise offer premiums. Second, toehold bidding is relevant to our setting because toeholds may impact the bidder's bargaining power with the target (represented here by our synergy sharing rule θ).[19]

[18] Based on the major four-digit SIC code of the target, approximately one-third of the sample targets are in manufacturing industries, one-quarter are in the financial industry, and one quarter are service companies. The remaining targets are spread over natural resources, trade and other industries.

[19] On the one hand, bidders benefit from toeholds due to the concomitant reduction in the number of target shares acquired at the full takeover premium, and because toehold bidders realize a capital gain on the toehold investment if a rival bidder wins the target. As these toehold benefits raise the bidder's valuation of the target, they may also deter potential rival bids, causing both lower takeover premiums and greater probability if winning the target (Bulow,

Toehold purchases are identified using the "acquisitions of partial interest" data item in SDC, where the buyer seeks to own less than 50% of the target shares. As shown in Panel A of Table 3, over the six months preceding bid announcement [-126,0], the initial control bidders acquire a total of 136 toeholds in 122 unique target firms. Of these stakes, 104 toeholds in 94 different targets are purchased over the 42 trading days leading up to and including the day of the announcement of the initial control bid. Thus, less than 2% of our initial control bidders acquire a toehold in the runup period. For 98% of the target firms, the initial control bidder does not buy any short-term toehold. The typical short-term toehold acquired by the initial bidder in the runup period is relatively large, with a mean of 12% (median 9%).

The timing of the toehold purchase during the runup period is important for their ability to generate takeover rumors. We find that two-thirds of the initial control bidders' toehold acquisitions are announced on the day of or the day before the initial control bid [-1,0]. Since the SEC allows investors ten days to file a 13(d), these toeholds have most likely been purchased sometime within the 10-day period preceding and including the offer announcement day. For these cases, the target stock-price runup does not contain information from a public Schedule 13(d) disclosure (but will of course still reflect any market microstructure impact of the trades). The remaining short-term toeholds are all traded and disclosed in the runup period.

Panels B and C of Table 3 show toehold purchases by rival control bidders (appearing later in the contest) and other investors. Rival bidders acquire a toehold in the runup period for only 3 target firms. The average size of these rival short-term toeholds are 7% (median 6%). Other investors, not bidding for control in the contest, acquire toeholds in 73 target firms (1% of target firms) during the 42 days preceding the control bid. The announcement of 21% (18 of 85) of these toeholds coincide with the announcement of the initial control bid, suggesting that rumors may trigger toehold purchases by other investors. Overall, there are few purchases of toeholds in the two-month period leading up to the initial control bid.

Huang, and Klemperer, 1999; Betton and Eckbo, 2000). On the other hand, bidder toehold benefits which in effect represent transfers from target shareholders or entrenched target management may induce costly target resistance (Betton, Eckbo, and Thorburn, 2009).

3.3 H1: The market return as a proxy for T

The model in Section 2.2 suggests that bidders will agree to the transfer of a known target stand-alone value change (T) to target shareholders in the form of a higher offer premium. Moreover, the model underlying equation (9) motivates subtracting T from the target runup in order to identify the nonlinear projection of markups on runups implied by deal anticipation. Possible proxies for T include the cumulative market return over the runup period, a CAPM benchmark (beta times the market return), or an industry adjustment. All of these are subject to their own varying degrees of measurement error. However, since any adding back of stand-alone value changes would have to be agreed upon by both the target and the bidder, a simpler measure is probably better. In our hypothesis H1, we therefore use the market return.

We test H1 using the linear regressions reported in Table 4, where the variables are defined in Table 5. The main focus of Table 4 is the initial offer premium regressions shown in columns 3–6. However, for descriptive purposes, we have also added two regressions explaining the net runup. All regressions control for toehold purchases in the runup period as well as for toeholds which the bidder has held for longer periods (the total toehold equals $Toeholdsize$). The dummy variables *Stake bidder* and *Stake other* indicate toehold purchases by the initial control bidder and any other bidder (including rivals), respectively, in the runup window through day 0.

Notice first that short-term toehold purchases by investors other than the initial bidder have a significantly positive impact on the net runup in the two first regressions. Furthermore, short-term toehold purchases by the initial bidder also increase the net runup, but with less impact on the runup: the coefficient for *Stake bidder* is 0.05 compared to a coefficient for *Stake other* of 0.12. While short-term toeholds tend to increase the runup, the total bidder toehold has the opposite effect: $Toehold\ size$ enters with a negative and significant sign. Thus, only the short-term toehold purchases have a positive impact on target runups.

Several of the other control variables for the target net runup receive significant coefficients. The smaller the target firm ($Target\ size$, defined as the log of target equity market capitalization) and the greater the relative drop in the target stock price from its 52-week high (52-*week high*, defined as the target stock return from the highest price over the 52 weeks ending on day -43), the higher the runup.[20] Moreover, the runup is higher when the acquirer is publicly traded and in tender offers, and lower for horizontal takeovers. The inclusion of year-fixed effects in the second column does not change any of the results.

Turning to tests of H1, the coefficients on $Market\ runup$ (defined as the market return during the runup period) is highly significant and close to one in all four offer premium regressions in Table 4. This is evidence that merger negotiations allow the market-driven portion of the target return to flow through to the target in the form of a higher offer premium—on a virtual one-to-one basis. Notice also that, while the net target runup (net of the market return) is also highly significant when included, the inclusion of $Net\ runup$ does not materially affect the size or significance of $Market\ runup$ nor the other control variables.[21]

As documented earlier (Betton and Eckbo, 2000; Betton, Eckbo, and Thorburn, 2009), toehold bidding tends to lower the offer premium ($Toehold\ size$ receives a statistically significant and negative coefficient). A new finding in Table 4, which is relevant for the question of a costly feedback loop, is that the dummy for short-term toehold purchases have no separate impact on offer premiums. This result emerges irrespective of whether the toehold purchase is by the initial control bidder or another investor. Thus, although short-term toehold acquisitions tend to increase the runup, the negotiating parties appear to adjust for this effect in determining the offer premium.[22]

Finally, offer premiums are decreasing in $Target\ size$ and in 52-$week\ high$, both of which are highly significant. Offer premiums are also higher in tender offers and when the acquirer is publicly traded. The greater offer premiums paid by public over private bidders is also reported by Bargeron, Schlingemann, Stulz, and Zutter (2007).

3.4 H2: Is the projection of markups on runups nonlinear?

Propositions 1 and Eq. (3), illustrated in Figure 3, prove that the relation between markups and runups will be nonlinear when the runup is driven by market anticipation of the expected takeover

[20] Baker, Pan, and Wurgler (2010) suggest that a variable such as 52-*week high* may represent psychological "anchoring" by the merging parties and also show that it affects bid premiums. Alternatively, this variable may be correlated with fundamental information on synergy gains from the takeover.

[21] Not surprisingly, inclusion of the net runup increases the regression R^2 substantially, from 8% to 34%. Notice also that inclusion of the market-adjusted industry return over the runup period does not add significance.

[22] Because the toehold decision is endogenous, we developed and tested a Heckman (1979) correction for endogeneity by including the estimated Mill's ratio in Table 4. The coefficient on the Mill's ratio is not statistically significant, and it is therefore not included here. Details are available in Betton, Eckbo, and Thorburn (2008b).

premium. To test for this nonlinearity, we proceed as follows. Suppose one were to estimate a linear projection of markups on runups, superimposed on the true nonlinear projection for, say, the case in Figure 3B where S given the synergy signal s has a normal distribution. Now, if we order the data by runup in the cross-section, the residuals from the linear projection should show a discernable pattern: moving from the left in Figure 3B (i.e., starting with low runups), the residuals should become less negative, then increasingly positive. At a point, the residuals should become less positive, move negative, then cycle around again.

This pattern will generate serial correlation in the residuals. Without any nonlinearity, the residuals should be serially uncorrelated because the deals, when ranked on runup have nothing to do with one another. Serial correlation should exist regardless of whether or not there is an upward sloping portion of the nonlinear projection of expected markup on runup. It should exist within any region of the data that creates meaningful nonlinearity in the expected markup. The idea that patterns in residuals are a specification test follows simply from the logic that the sum of residuals from a correctly specified model having normally distributed errors should form a discrete Brownian Bridge from zero to zero regardless of how the independent variables are ordered.[23]

To test for this serial correlation in residuals, we begin with the first linear regression specification in Table 6. In projection specification (1), the markup and the runup are defined using the offer price and the total target return in the runup period. The linear projection has an intercept of 0.36 and a slope of -.24. Next, we order the data by runup and then calculate the residuals from this projection. The first-order serial correlation coefficient for the residuals sorted this way is 0.030 with a statistically significant t-ratio of 2.36. This positive serial correlation rejects linearity.[24]

A rejection of linearity, however, does not clarify the nature of the rejection. The form of the non-linearity might be at odds with the theoretical prediction of a general concave then convex shape shown in Figure 3. We therefore fit a flexible functional form to the data patterned after the beta distribution, denoted $\Lambda(v, w)$ where v and w are shape parameters. The beta density is convenient because it is linear downward sloping when the shape parameters are $v = 1$ and $w = 2$. For other shape parameters the density can be concave, convex, peaked at the left, right or both

[23]A Brownian Bridge is a random walk process cumulating between known points, e.g., random residuals starting at zero and summing to zero across a sample of data. Cumulative residuals in an OLS regression with normally distributed errors are, by construction, a Brownian Bridge.

[24]With 6,000+ observations, it is safe to ignore the slightly negative correlation caused in random linear data by the constraint that the residuals must sum to zero.

tails or unimodal with the hump toward the right or left. Our model in Section 2.1 suggests a unimodal fit with the hump to the left and the right tail convex and falling to zero as deals become increasingly certain.

Applying the beta density to the markup data, write

$$Markup = \alpha + \beta[(r - min)^{(v-1)}(max - r)^{w-1}/\Lambda(v, w)(max - min)^{v+w-1}] + \epsilon, \tag{16}$$

where r is the runup, max and min are respectively the maximum and minimum runups in the data, α is an overall intercept, and β is a scale parameter, and ϵ is a residual error term. If the parameters v and w are set respectively to 1 and 2, a least squares fit of the markup to the runup (allowing α and β to vary) will produce an α and β that replicate a simple linear regression. The intercept and slope need to be translated because v and w impose a particular slope and intercept on the data, which α and β modify. A least squares fit over all four parameters allows the data to find a best non-linear shape within the constraints of the flexibility allowed by the beta density. As suggested, this density is quite flexible.

Continuing with projection (1) in Table 6, the nonlinear estimation reduces the residual serial correlation from 0.030 with the best linear form to 0.015 with the best nonlinear form. since the latter has a t-statistic of only 1.15, this shows that the nonlinear fit eliminates the statistically significant serial correlation from the linear fit. This is consistent with the deal anticipation hypothesis (H2) for the runup.

Hypothesis H2 can also be examined by visually comparing the shape of the estimated nonlinear curve in Figure 6 to that of the theoretical form in Figure 3. Figure 6A shows both the linear and best nonlinear fit of the markup on the runup corresponding to projection (1) in Table 6. The graph displays the fitted curves along with the data cloud. Obviously, the data are quite noisy since the fits explains only about 3 to 6 percent of the variation. Still, the figure is strikingly similar to the theoretical shape in Figure 3B with normally distributed signal errors. Overall, this evidence is strongly supportive of the nonlinearity that prior anticipation creates.[25]

[25]While not shown in the paper, we find that nonlinearity is enhanced by subtracting from the runup a market-model alpha measured over the year prior to the runup. A consistent explanation is that recent pre-runup negative target performance indicates synergy benefits to the takeover (e.g. inefficient management) which are factored into offer premiums. We also find that bid premiums are significantly negatively correlated with prior market model alphas, further supporting this line of thinking.

We next turn to a number of robustness checks on the above conclusion, based on the remaining projections in Table 6. While the corresponding figures are not shown, we can report that for all of these projections, the resulting form of the non-linearity corresponds closely to that in Figure 6A for projection (1), and are thus consistent with the general concave then convex shape shown in the theoretical Figure 3.

3.5 Robustness checks for H2

3.5.1 The probability of contest success

As defined earlier, the theoretical premium variable V_P is the expected premium conditional on the initial bid. Some bids fail, in which case the target receives zero premium. Presumably, the market reaction to the bid adjusts for an estimate of the probability of an ultimate control change. This is apparent from Figure 1 where the target stock price on average runs up to just below 30% while the average offer premium in Table 2 is 45%.

The standard approach to adjust for the probability of success is to cumulate abnormal stock returns over a period after the first bid thought to capture the final contest outcome.[26] However, long windows of cumulation introduces a substantial measurement error in the parameters of the return generating process. Moreover, cross-sectionally fixed windows introduces error in terms of hitting the actual outcome date. One could tailor the event window to the outcome date for each target, however, outcome dates are not always available to the researcher.

Our approach is instead to use the initial offer price (which is known) and to adjust this offer for an estimate of the target success probability (where target failure means that no bidder wins the contest). We do this in two ways. The first is to restrict the sample to those targets which we know succeeded (ex post). This is the sample of 5,035 targets used in projection (2) in Table 6 (so the unconditional sample success probability is 5,035/6,150=0.82). This projection also shows significant linear residual serial correlation followed by a substantial reduction of this correlation when using the nonlinear form. Notice that the nonlinear residual correlation remains significantly different from zero, which means that the nonlinear form is not now able to remove completely the serial correlation in the data. However, this is not a rejection of nonlinearity.

[26]For example, Schwert (1996) use a window of cumulation through 126 trading days following the bid date.

The second adjustment for the probability of target success uses much more of the information in the sample. It begins by estimating the probability of contest success using probit. The results of the probit estimation is shown in columns 1 and 2 of Table 7. The dependent variable takes on a value of one if the target is ultimately acquired either by the initial bidder or a rival bidder, and zero otherwise. The explanatory variables are again as defined in Table 5.

The probit regressions for contest success are significant with an pseudo-R^2 of 21%-22%. The difference between the first and the second column is that the latter includes two dummy variables for the 1990s and the 2000s, respectively.[27] The probability that the takeover is successful increases with the size of the target, and is higher for public acquirers and in horizontal transactions. Bids for targets traded on NYSE or Amex, targets with a relatively high stock turnover (average daily trading volume, defined as the ratio of the number of shares traded and the number of shares outstanding, over days -252 to -43), and targets with a poison pill have a lower likelihood of succeeding.

A high offer premium also tends to increase the probability of takeover success, as does a relatively small run-down from the 52-week high target stock price. Moreover, the coefficients for three dummy variables indicating a positive bidder toehold in the target (*Toehold*), a stock consideration exceeding 20% of the bidder's shares outstanding and thus requires acquirer shareholder approval ($>$ 20% *new equity*), and a hostile (vs. friendly or neutral) target reaction (*Hostile*), respectively, are all negative and significant. Finally, contests starting with a tender offer are more likely to succeed, as are contests announced in the 1990s and the 2000s. The dummy variable indicating an all-cash bid generates a significantly negative coefficient only when controlling for the time period (Column 2).

There are a total 6,103 targets with available data on the characteristics used in the probit estimation. For each of these, we multiply the markup with the estimated success probability computed using the second model in Table 7 (which includes the two decade dummies). This "expected markup" is then used in the nonlinear projection (3) reported in Table 6. Interestingly, the nonlinear form are now again able to remove the significant linear residual serial correlation from 0.027 (t=2.11) to an insignificant 0.016 (t=1.25) with the nonlinear estimation.[28]

[27] All takeovers in the early 1980s were successful, prohibiting the use of year dummies.

[28] Table 7, in columns 3-6, also show the coefficients from probit estimations of the probability that the initial control bidder wins the takeover contest. The pseudo-R^2 is somewhat higher than for this success probability, ranging from

3.5.2 Information known before the runup period

Up to this point, we have assumed that the market imparts a vanishingly small likelihood of a takeover into the target price before the beginning of the runup period (day -42 in Figure 1). However, the market possibly receives information prior to the runup period that informs both the expected bid if a bid is made and the likelihood of a bid. To illustrate, consider the case where the market has a signal z at time zero. During the runup, the market receives a second signal s and, finally, a bid is made if $s+z$ exceeds a threshold level of synergy gains.

Working through the valuations, we have one important change. Define $\pi(z)E(B|z)$ as the expected value of takeover prospects given z and a diffuse prior on s. We then have that, at time zero in our model (event day -42 in our empirical analysis), $V_0 = \pi(z)E(B|z)$, and the runup and the bid premium would now be measured relative to V_0. Instead of V_R, the runup measured over the runup period is now

$$V_R - V_0 = \pi(s+z)E_{s+z}[B(S,C)] + T|s+z, bid] + [1-\pi(s+z)]T - \pi(z)E(B|z), \tag{17}$$

and the premium is

$$V_P - V_0 = E_{s+z}[B(S,C) + T|s+z, bid] - \pi(z)E(B|z)] - \pi(z)E(B|z). \tag{18}$$

Setting aside the influence of T, for an investigation into the nonlinear influence of prior anticipation, one would want to add back V_0 to both the runup and the bid premium. Since the influence of V_0 is a negative one-for-one on both quantities, markups are not affected.

In order to unwind the influence of a possibly known takeover signal z prior to the runup period, we use the following three deal characteristics defined earlier in Table 5: *Positive toehold*, *Toehold size*, and the negative value of $52-$*week high*. The positive toehold means that the bidder at some point in the past acquired a toehold in the target, which may have caused some market

22% to 28%. Columns 3 and 4 use the same models as the earlier estimations of contest success, while columns 5 and 6 add a variable capturing the percent of target shares owned by the initial control bidder at the time of the bid (*Toehold size*). Almost all explanatory variables generate coefficients that are similar in size, direction, and significance level to the ones in the probit regressions of contest success. The reason is that in the vast majority of successful contests, it is the initial bidder who wins control of the target. The only difference between the probability estimations is that the existence of a target poison pill does not substantially affect the likelihood that the initial bidder wins. The larger the initial bidder toehold, however, the greater is the probability that the initial bidder wins.

anticipation of a future takeover. Moreover, it is reasonable to assume that the signal is increasing in the size of the toehold. Also, we know from Baker, Pan, and Wurgler (2010) and Table 4 above that the target's 52-week high return impacts the takeover premium.

Using these variables, model (4) reported in Table 6 implements two multivariate adjustments to model (1). The first adjustment, as dictated by eq. (17), augments the runup by adding R_0, where R_0 is the projection of the total runup ($\frac{P_{-2}}{P_{-42}}-1$) on $Positive\ toehold$, $Toehold\ size$, and the negative value of $52-week\ high$. The second adjustment is to use as dependent variable the "residual markup U_P, which is the residual from the projection of the total markup, $\frac{OP}{P_{-2}}-1$, on the deal characteristics used to estimate the success probability π in Table 7, excluding $Positive\ toehold$, $Toehold\ size$, and $52-week\ high$ which are used to construct the augmented runup.

Model (4) in Table 6 shows the linear and nonlinear projections of the residual markup on the augmented runup. The linear slope remains negative and highly significant (slope of -0.21, t-value of -12.1). The serial correlation of the ordered residuals from the linear projection is 0.052 with t-value of 4.03. After the nonlinear fit, the serial correlation drops to 0.031 with a t-value of 2.45. In this experiment the shape looks similar to the other nonlinear fits except that the right tail tips upward slightly. Thus, this evidence also supports the presence of a deal anticipation effect in the runup measured over the runup period.

3.5.3 Projections using abnormal stock returns

The last projection in Table 6 uses cumulative abnormal stock returns (CAR) to measure both the markup, $CAR(-1,1)$, and the runup, $CAR(-42,-2)$. CAR is estimated using the market model. The parameters of the return generating model are estimated on stock returns from day -297 through day -43. The CAR uses the model prediction errors over the event period (day -42 through day +1). Note that in this projection, the market-driven portion of the target runup has been netted out.

The linear residual serial correlation is a significant 0.039 (t=3.10), which is almost unchanged in the nonlinear form. Thus, we can reject the linearity of the projection. However, our specific nonlinear fit fails to remove the serial correlation. Interestingly, notice from Panel B of Figure 6 that the shape of our nonlinear form looks very much like the form in Panel A, in which the nonlinear form does succeed in eliminating the residual serial correlation.

4 Deal anticipation and bidder valuations

We have so far examined the relationship between offer markups and target runups. As we show in this section, rational bidding has important empirical implications for the relationship between target runups and bidder takeover gains given that bids are made. We proceed to test these implications and integrate the test results with the evidence from the previous section to make our overall evaluation of the deal anticipation and costly feedback hypotheses (H2 and H3).

4.1 Bidder takeover gains and target runups

Let ν denote bidder valuations, again measured in excess of stand-alone valuation at the beginning of the runup period. Valuation equations for the bidder are:

$$\nu_R = \int_K^{\infty} (S - C - B(S,C))g(S)dS, \tag{19}$$

where ν_R has the same interpretation as V_R for targets. At the moment of a bid announcement, but without knowing precisely what the final bid is, we again have that

$$\nu_P = \frac{1}{\pi(s)} \int_K^{\infty} (S - C - B(S,C))g(S)dS. \tag{20}$$

The observed valuation of the bidder after the bid is announced includes an uncorrelated random error around the expectation in equation (20) driven by the resolution of S around its conditional expectation.

Proposition 4 (rational bidding): *Let G denote the bidder net gains from the takeover ($G = S - C - B$). For a fixed benefit function G, rational bidding behavior implies the following:*
(i) Bidder and target synergy gains are positively correlated: $Cov(G, B) > 0$.
(ii) Bidder synergy gains and target runup are positively correlated: $Cov(G, V_R) > 0$.
(iii) The sign of the correlation between G and target markup $V_P - V_R$ is ambiguous.

Proof: See Appendix A.

Rational bidding in our context means that the bidder decides to bid based the correct value of

K. Figure 7 shows the theoretical relation between the bidder expected benefit ν_P and the target runup V_R for the uniform case with $\theta = 0.5$ and $\gamma = 1$. In panels A and B, the bidder rationally adjusts the bid threshold K to the scenario being considered: In Panel A, there is no transfer of the runup to the target, and so $K = \frac{\gamma C}{\theta}$ as in equations (1) and (2). In Panel B, the bidder transfers the runup, but also rationally adjusts the synergy threshold to $K^* = \frac{\gamma C + V_R}{\theta}$ (as in Section 2.3 above). In either case, the bidder expected benefit ν_P is increasing and concave in the target runup. Notice also from Part (iii) of Proposition 3 that the most powerful test of the proposition comes from regressing the bidder gain on the target runup only—where the predicted sign is positive. The predicted sign between the bidder gain and the target markup is indeterminate.

Finally, in Panel C of Figure 7, the bidder transfers the target runup but fails to rationally adjust the bid threshold from K to K^*. In this case, the bidder expected benefit is declining in V_R except at the very low end of the synergy signals which create very small runups.

4.2 H2: Are bidder gains increasing in target runups?

Proposition 4 and Panels A and B of Figure 7 show that, with rational market pricing and bidder behavior, bidder takeover gains ν_P are increasing in the target runup V_R. Bidder gains ν_P are decreasing in the target runup only if bidders fail to rationally compute the correct bid threshold level K. In this section we test this proposition empirically using the publicly traded bidders in our sample. We estimate ν_P as the cumulative abnormal bidder stock return, $BCAR(-42, 1)$, using a market model regression estimated over the period from day -297 through day -43 relative to the initial offer announcement date. The sample is N=3,691 initial control bids by U.S. publicly traded firms.

Table 8 shows linear projections of $BCAR(-42, 1)$ on our measures of target runups from Table 6. As predicted, the target runup receives a positive and significant coefficient in all six models in Table 8. All models are estimated with year dummies. In model (1), which uses the total target runup, the coefficient is 0.049 with a p-value of 0.006. Model (2) adds a number of controls for target-, bidder-, and deal characteristics, listed in the footnote of the table and also used in the estimation of the probability of success (Table 7). With these control variables, the slope coefficient on the target total runup is 0.054.[29]

[29]Of the control variables, *Relative size* and *All cash* receive significantly positive coefficients, while *Turnover*

In model (3), the target runup is net of the market return over the runup period and it receives a coefficient of 0.078 (p-value of 0.000). Model (4) again augments model (3) with the control variables, with a slope coefficient on the target net runup of 0.082. In model (5), the target runup is the *Augmented Target Runup* from Table 6 (to account for information about merger activity prior to the runup period). The slope coefficient is 0.049, again highly significant. Finally, Table 8 reports the projection of $BCAR$ on the market model target runup $CAR(-42, 2)$. The slope coefficient is 0.148 with a p-value of 0.000, again as predicted by our theory.

Next, we describe the full functional form of the projection of $BCAR$ on target runup. Consistent with the results of Table 8, the best linear projection of $BCAR$ on V_R shown in Figure 8 produces a significantly positive slope coefficient of 0.045 (the intercept is -0.019). The linear residual serial correlation is an insignificant 0.021 (t=1.27). After fitting the nonlinear model, the residual serial correlation drops to 0.016 (t=0.99). In Panel B of Figure 8, $BCAR$ is projected on the augmented target runup, producing an almost identical nonlinear shape.

Overall, the results of Table 8 and Panels A and B of Figure 8 show that the nonlinear fit of $BCAR$ on V_R is upward sloping and concave in V_R. The empirical shapes in Figure 8 have a striking visual similarity to the theoretical projections in panels A and B of Figure 7. The positive and monotone relationship between $BCAR$ and V_R rejects irrational bidding. Moreover, this evidence rejects *a fortiori* the negative relation shown in Panel C of Figure 7 implied by the case where the bidder agrees to a full transfer of the runup to the target without rationally adjusting the bid threshold K. The evidence is, however, fully consistent with hypothesis H2 that runups reflect rational market deal anticipation and are interpreted as such by the parties to the merger negotiations.

5 Conclusions

There is growing interest in financial market feedback loops, in which economic agents may take corrective action based on information in stock price changes. We study this phenomenon in the rich context of offer price bargaining where the negotiating parties observe an economically significant target stock price runup. Since the true source of the runup (target stand-alone value change and/or

receives a significantly negative coefficient.

deal anticipation) is unobservable, it is subject to interpretation by the bargaining parties which may result in a correction of the planned offer price. The problem for the bidder is that correcting the offer price when the runup reflects deal anticipation means literally paying twice for the target shares. Thus the outcome of this feedback loop is important for the incentive to make bids and, therefore, for the efficiency of the takeover process.

Earlier papers have examined this issue empirically by estimating the slope coefficient in linear cross-sectional regressions of the offer price markup (the offer price minus the runup) on the runup. Causal intuition suggests that this slope coefficient should be negative one under the deal anticipation hypothesis, as the runup substitutes dollar for dollar for the offer price markup. By extension, finding a coefficient greater than negative one has been taken to mean that runups tend to result in costly offer price markups.

Our analysis produces very different theoretical insights and empirical conclusions. First, rational market pricing implies a theoretical slope coefficient involving the conditional takeover probability $\pi(s)$ when markups are projected on runups. This means that the projection is generally nonlinear and non-monotonic in the synergy signal (s) and with a specific shape which we identify. We also prove that when bidders mark up offers with target runups that are caused by deal anticipation (costly feedback loop), the projection of markups on runups is strictly positive—and not zero as previously thought.

Our large-sample projection of offer price markups on runups yields a significantly negative slope coefficient. Moreover, the nonlinear form of the empirical projection is remarkably closely to the theoretical prediction. This evidence has two main implications. First, the nonlinearity fails to reject the hypothesis (H2) that target runups are caused by rational deal anticipation. Second, the negative slope coefficient rejects the costly feedback hypothesis (H3) in which runups caused by deal anticipation are fed back into the offer price.

A third implication of the deal anticipation hypothesis, coupled with rational bidding, is that of a positive relationship between *bidder* takeover gains and target runups. Cross-sectional regression of bidder abnormal returns on target runups confirm this prediction as well. This suggests that the pre-bid target runup is an empirical proxy not only for expected target takeover benefits but also for total expected synergies, as the rational deal anticipation theory predicts.

We also discover that offer premiums tend to be marked up almost dollar for dollar by the *market return* over the runup period. This is consistent with our hypothesis H1 that the market component of the runup is interpreted by the negotiations as an exogenous change in the target's stand-alone value. It may therefore be safely transferred to the target without the risk of paying twice.

Finally, we find that toehold purchases in the runup period (that is, block trades in the target shares by either the bidder or some other investor) tend to fuel target runups. Nevertheless, there is no evidence that the increased target runup also increases offer premium markups. If anything, toehold bidding reduces offer premiums and offer price markups. A consistent interpretation of this result is that bidders are able to convince their target counterparts that the extra runup caused by their toehold purchases reflects deal anticipation rather than an increase target stand-alone values. If this interpretation is correct, target runups fueled by toehold purchases in the runup period do not add to the bidder's cost of the takeover.

A Appendix: Proof of Proposition 4

Proposition 4 (rational bidding): *Let G denote the bidder synergy gains from the takeover. For a fixed benefit function G, rational bidding behavior implies the following:*

(1) Bidder and target synergy gains are positively correlated: $Cov(G, B) > 0$:

(ii) Bidder synergy gains and target runup are positively correlated: $Cov(G, V_R) > 0$

(iii) The sign of the correlation between G and target markup $V_P - V_R$ is ambiguous.

Proof: For the first part (i), recall that we have assumed that, if a bid is made, the bidder and target share in the synergy gains $(1 < \theta < 1)$, implying $0 < \frac{\partial B(S,C)}{\partial S} < 1$. It follows immediately that both the bidder and target gains increase in S throughout the entire range of S wherein bids are possible. This includes ranges over which bids are certain given the signal, s. In the case of our closed form example above, write out the target gain, $B = (1-\theta)S - (1-\gamma)C$, and the bidder gain, $G = \theta S - \gamma C$. Clearly, both B and G are increasing (and linear) in S.[30] To prove the rest of Proposition 4 it is necessary to work with the conditional distribution of s given S, which we denote $f(s|S)$. Knowledge of $f(s|S)$ is required to determine the expected value of the runup for a given observed S, revealed when the bid is made. When S is revealed through the bid, s is random in the sense that many signals could have been received prior to the revelation of S. For (ii), the covariance between the target runup and the bidder gains is the covariance between the expected runup, at a given S, and the bidder gain, at the same S. This covariance is measured by the product of derivatives so it suffices to show that the derivative of the expected runup is always positive to prove the second part of the proposition. To prove the last part (iii) of the proposition, it must be shown that the derivative of the expected markup is not always less than $1 - \theta$ for all S.

While proof of (ii) and (iii) can be generalized, we focus on the case where the prior distribution of S is diffuse and the posterior distribution of S, given s is uniform (our closed-form example). With diffuse prior, the law of inverse probability implies that $f(s|S)$ is proportional to the posterior

[30] In the example, and measuring $Cov(G, B)$ as the product of the derivatives of G and B w.r.t. S, $Cov(G, B) = \theta(1-\theta)$. This means that the expected "slope coefficient" of a projection of G on B equals $\theta/(1-\theta)$.

distribution of S given s, or $f(s|S) \sim U(S-\Delta,\ S+\Delta)$. We now have

$$E_s(V_R) \propto \int_{S-\Delta}^{S+\Delta} V_R(s) f(s|S) ds \tag{21}$$

Since $f(s|S)$ is a constant in our case, differentiation by S through Leibnitz rule gives the simple form:

$$\frac{\partial E_s(V_R)}{\partial S} = V_R(s = S+\Delta) - V_R(s = S-\Delta) \tag{22}$$

By inspection, $V_R(s)$ in equation (4) is increasing in s. This establishes that the $Cov(G, E(V_R)) > 0$ for all viable bids including bids which are certain.

Part (iii) of proposition 4 relates to $Cov(G,\ E_s(V_R))$. Since the target markup equals $B - E_s(V_R)$, we need to evaluate the sign of the derivative of this difference with respect to S. Define $E[M(S)] = B - E_s(V_R)$. Applying similar logic,

$$\frac{\partial E(M)}{\partial S} = (1-\theta) - [V_R(S+\Delta) - V_R(S-\Delta)] \tag{23}$$

Inspection of Figure 3 clearly shows that the "slope" of the difference in runups at $S+\Delta$ an $S-\Delta$ depends on S and need not be less than $1-\theta$, the slope of V_P in the figure. Thus the covariance between bidder gain and expected target markup need not be positive in a sample of data drawn over any range of S. If the range of S happens to cover (uniformly) the entire range of viable bids that are uncertain, there is no clear covariance between bidder gain and expected target markup.■

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Figure 1
The takeover information arrival process and average target runup in event time.

The runup period is measured from day -42 through day -2 relative to the first public offer for the target (day 0). The offer announcement period is day -1 through +1. The figure plots the percent average target abnormal (market risk adjusted) stock return in the runup and announcement periods for the total sample of 6,150 U.S. public targets (1980-2008). The average abnormal return in the runup period is 12% while the announcement-period return (markup) is 25%.

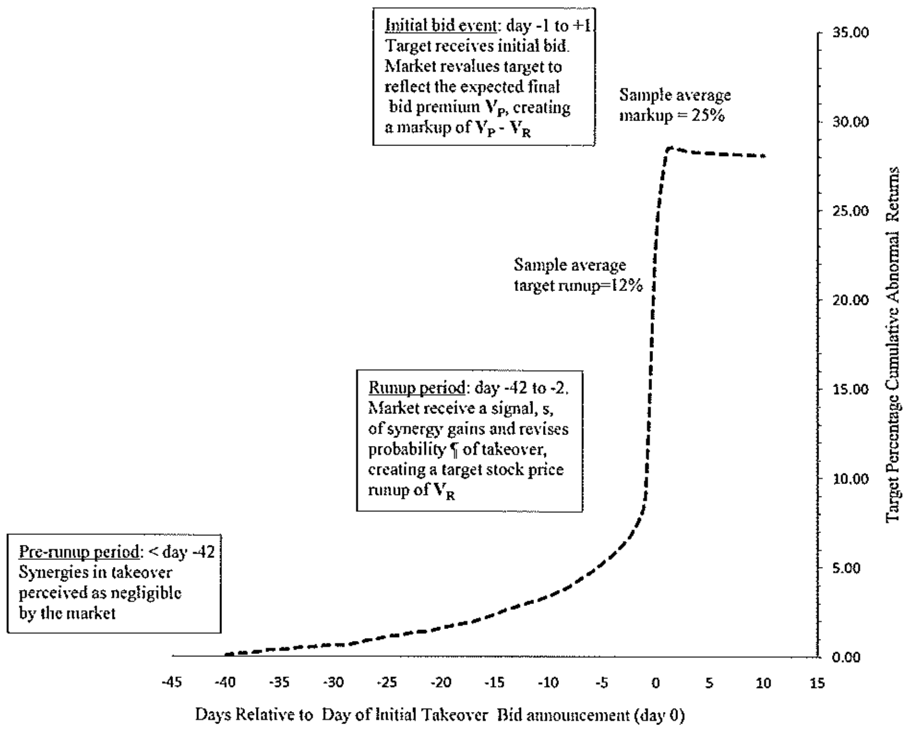
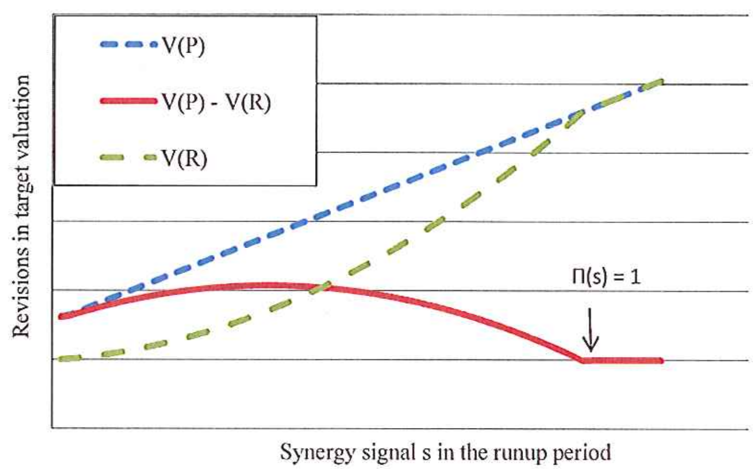


Figure 2
Rumor-induced target valuation changes under rational deal anticipation.

The market receives a synergy signal (rumor) s in the runup period. V_R is the expected target runup conditional on s, V_P is the expected offer price, $V_P - V_R$ is the offer price markup, and $\pi(s)$ is the probability of a takeover given s. In Panel A, the uncertainty in the synergy S given s has a uniform distribution with $\Delta = 3$, while in Panel B it has a normal distribution with the same standard deviation ($\frac{\delta}{\sqrt{3}} = 1.73$). The takeover benefit function has target and bidder equally sharing synergy gains ($\theta = 0.5$), while bidder bears the bid cost ($C = 0.3$ and $\gamma = 1$). The expected markup approaches zero as the anticipated deal probability $\pi(s)$ approaches one (which happens when $S > K = \frac{\gamma C}{\theta}$).

A: Valuation changes conditional on a uniform synergy signal s and on a bid



B: Valuation changes conditional on a normal synergy signal s and on a bid

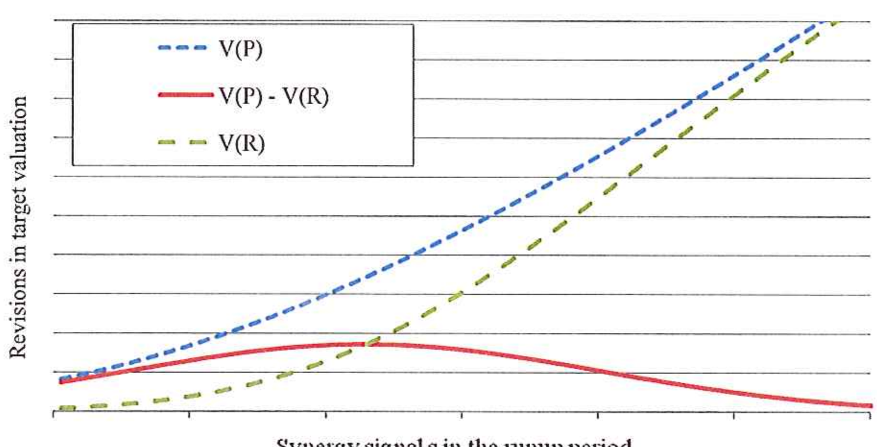


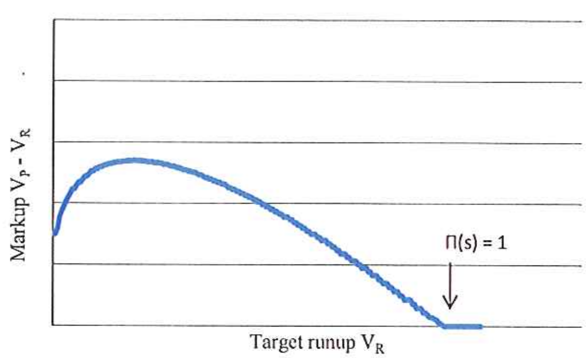
Figure 3
Projections of markups on runups under rational deal anticipation.

The projection is Eq. (3) in the text:

$$V_P - V_R = \frac{1-\pi(s)}{\pi(s)} V_R,$$

where V_P is the expected offer price, V_R is the expected target runup, and $\pi(s)$ is the probability of a takeover bid conditional on the synergy signal s in the runup period. While all parameter values are as in Figure 2, in this figure the x axis is transformed from s to the expected target runup. In Panel A, the synergy S given s is distributed uniform, while in Panel B it has a normal distribution. The expected markup approaches zero as the anticipated deal probability $\pi(s)$ approaches one.

A: Projection with true synergies uniformly distributed around signal



B: Projection with true synergies normally distributed around signal

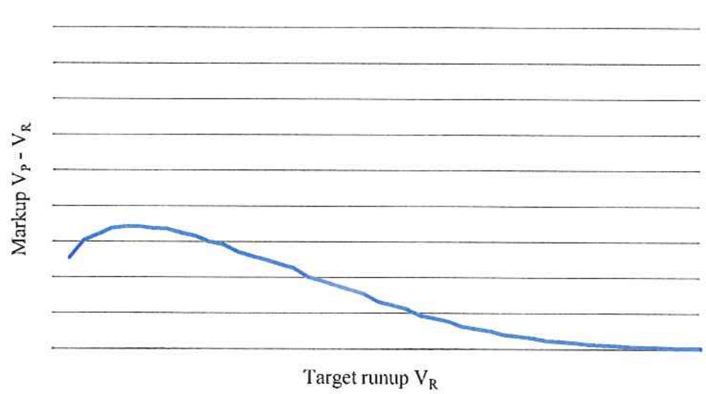


Figure 4
Markup projections with a known stand-alone value change T in the runup.

The projection is Eq. (9) in the text:

$$V_{PT} - V_{RT} = \frac{1 - \pi(s)}{\pi(s)}[V_{RT} - T],$$

where the subscripts add T to indicate values inclusive of stand-alone value change. The market receives a synergy signal (rumor) s in the runup period, distributed uniform, which generates a takeover probability $\pi(s)$. The figure shows that sample variation in T flattens the projection of markup on runup. The solid line is the average expected markup computed as the vertical summation of expected markups occurring across sub-samples with different changes in target stand-alone value T. Dashed lines are relations within a sub-sample having the same change in target stand-alone value. Benefit sharing is as in Figure 2.

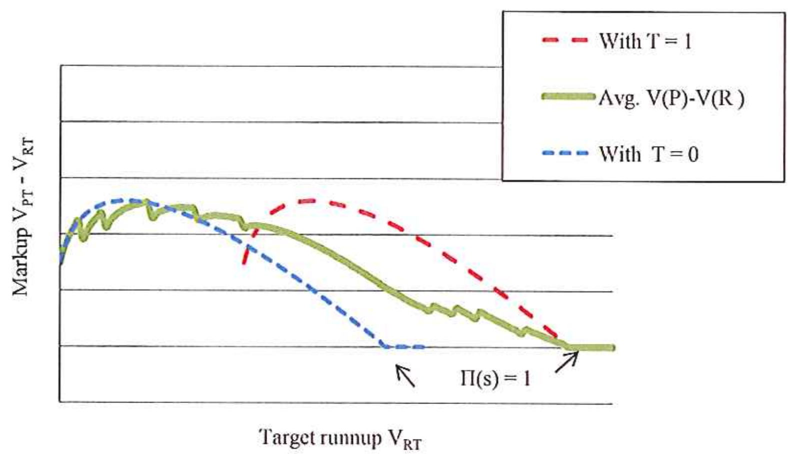
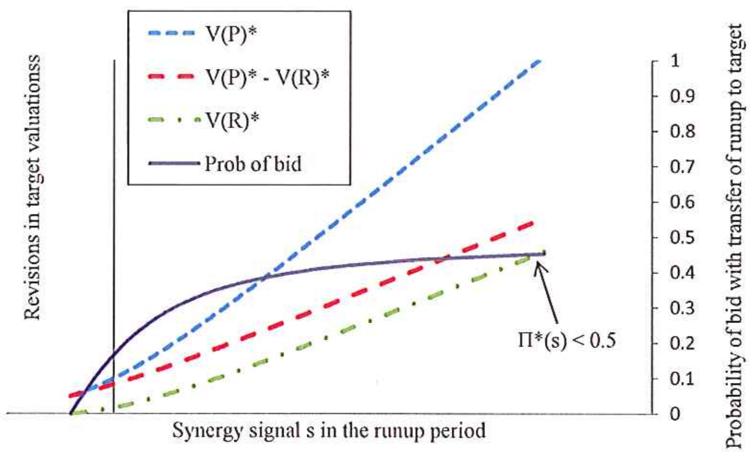


Figure 5
Markup projections with costly feedback loop (runup transferred to target).

The synergy S is distributed uniform around the signal s with $\theta = 0.5$ and $\gamma = 1$. Bidding cost are $C = 1$ and the uncertainty in S is $\Delta = 4$. Including V_R in the bid lowers the conditional probability of a takeover (shown in the right-side vertical axis of Panel A) as it eliminates relatively low-synergy takeovers from the sample, and this probability converges to $\theta = 0.5$. Panel B shows the projection of the markup on the runup corresponding to Panel A.

A: Valuation changes with transfer of runup to target



B: Projection of V_p*-V_R* on V_R* with transfer of runup to target

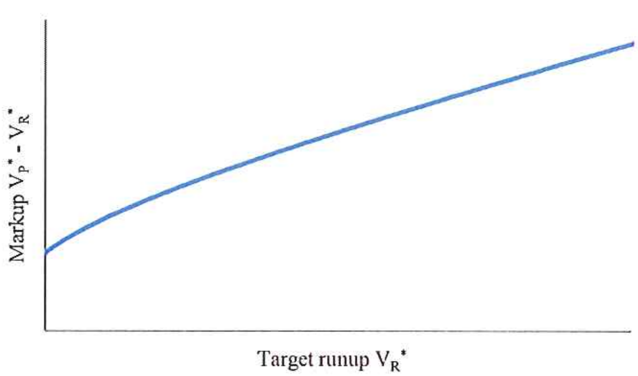


Figure 6
Markup projections for the total sample of 6,150 bids, 1980-2008.

In Panel A, the markup is measured as $\frac{OP}{P_{-2}} - 1$, where OP is the offer price and P_{-2} is the target stock price on day -2 relative to the first offer announcement date, and the runup is $\frac{P_{-2}}{P_{-42}} - 1$. In Panel B, the markup is the Market Model $CAR(-1,1)$ and the runup is $CAR(-42,-2)$. A flexible form (equation 16 in the text) is used to contrast linear fit with best fit.

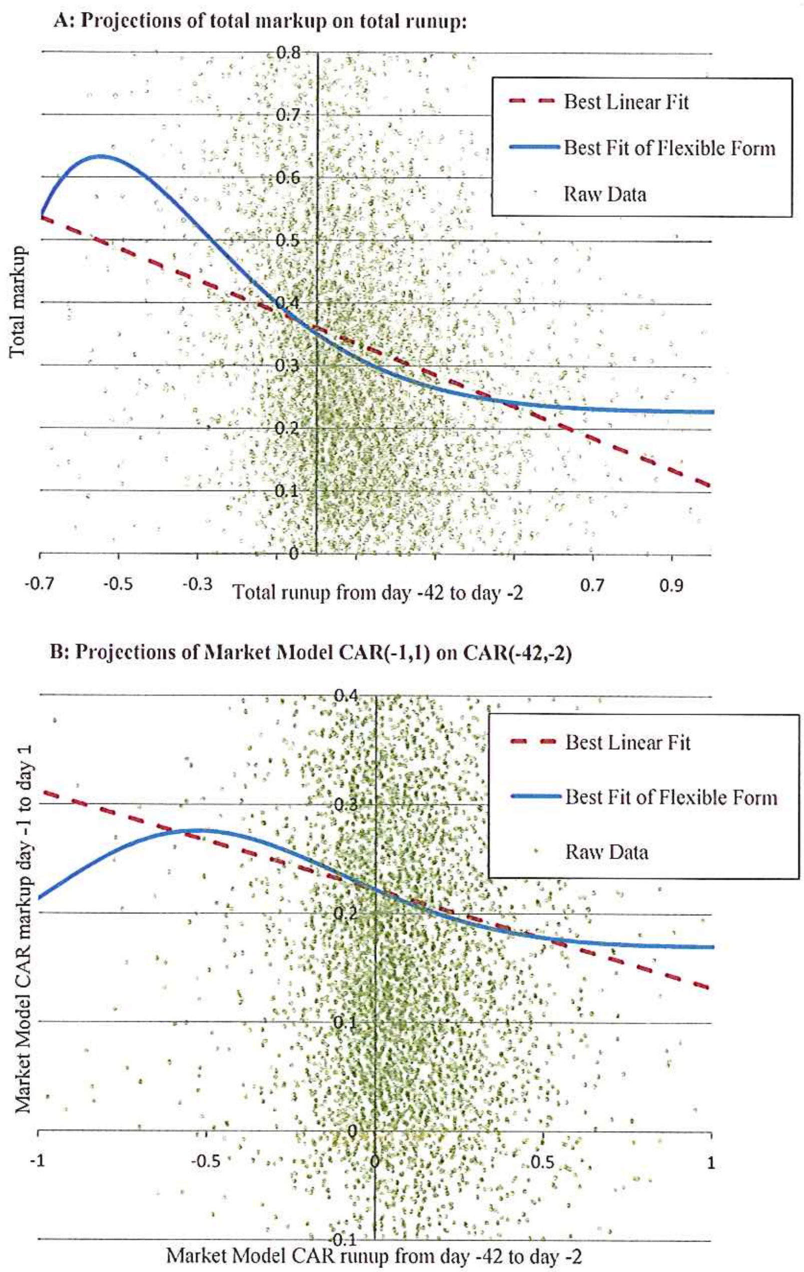
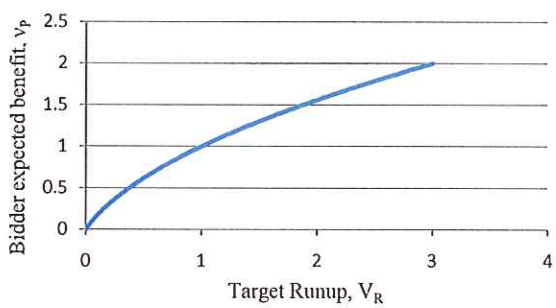


Figure 7

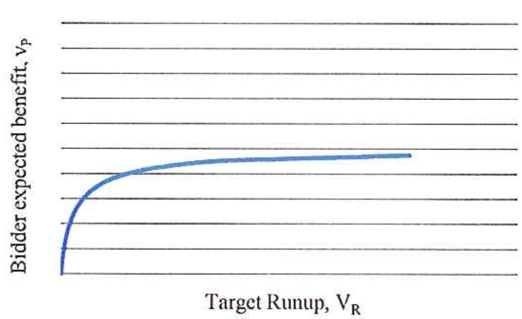
Projections of bidder merger gains ν_P on target runup with and without feedback loop.

The market receives a synergy signal s in the runup period resulting in the conditional expected synergy to be embedded into the stock prices of the bidder and the target. Uniform case with bidder and target sharing equally the synergy gains ($\theta = 0.5$) and bidder bearing all bid costs ($\gamma = 1$). In Panel A, the bidder does not transfer the runup V_R to the target. In Panel B, bidder transfers V_R and rationally adjusts the minimum bid threshold to $K^* = \frac{\gamma C + V_R}{\theta}$. In Panel C, bidder also transfers V_R to the target but does not adjust the minimum bid threshold to $K^* =$ (it remains at $K = \frac{\gamma C}{\theta}$). Thus, in both Panel B and C the bidder "pays twice", but only in Panel C does the bidder fail to take this extra takeover cost into account ex ante.

A: Bidder does not transfer runup V_R to target



B: Bidder transfers V_R to the target but bids only on beneficial deals (alters the bid threshold K)



C: Bidder transfers V_R to the target but does not alter the bid threshold K (suboptimal behavior).

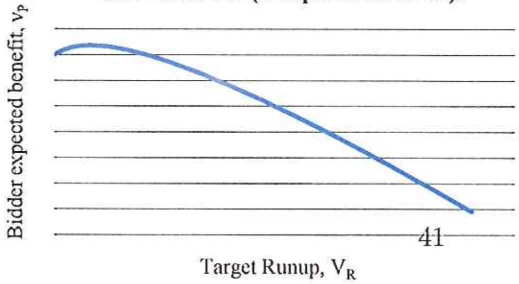


Figure 8
Projections of bidder gains on target runups for the total sample, 1980-2008.

Bidder takeover gains (ν_P) is measured as the Market Model bidder $CAR(-42, 1)$ relative to the first announcement date of the offer. In Panel A, the target runup is $\frac{P_{-2}}{P_{-42}} - 1$, where P_{-2} is the target stock price on day -2 relative to the first offer announcement date. Panel B uses the augmented target runup (defined in the text and in Table 6). A flexible form (equation 16 in the text) is used to contrast linear fit with best fit. Sample of 3,689 public bidders.

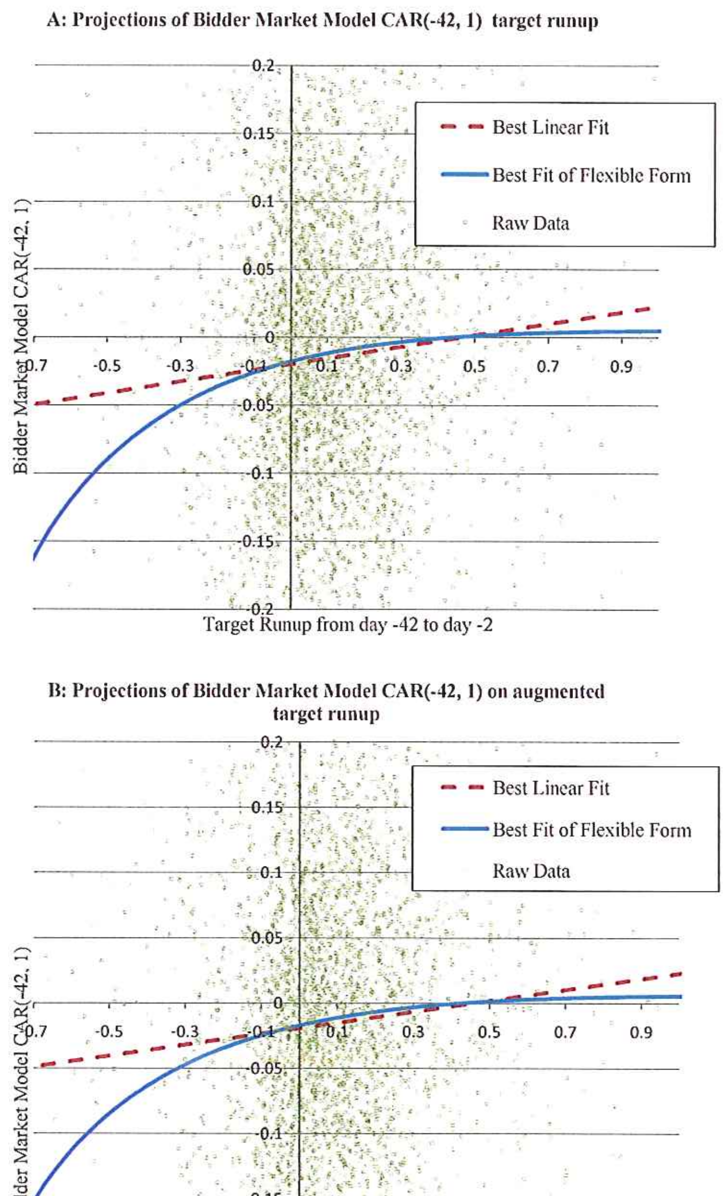


Table 1
Sample selection

Description of the sample selection process. An initial bid is the first control bid for the target in 126 trading days (six months). Bids are grouped into takeover contests, which end when there are no new control bids for the target in 126 trading days. All stock prices p_i are adjusted for splits and dividends, where i is the trading day relative to the date of announcement (day 0).

Selection criteria	Source	Number of exclusions	Sample size
All initial controlbids in SDC (FORMC = M, AM) for US public targets during the period 1/1980-12/2008	SDC		13,893
Bidder owns <50% of the target shares at the time of the bid	SDC	46	13,847
Target firm has at least 100 days of common stock returns in CRSP over the estimation period (day -297 to -43) and is listed on NYSE, AMEX or NASDAQ	CRSP	4,138	9,109
Deal value > $10 million	SDC	1,816	7,293
Target stock price on day -42 > $1	CRSP	191	7,102
Offer price available	SDC	239	6,863
Target stock price on day -2 available	CRSP	6	6,857
Target announcement returns [-1,1] available	CRSP	119	6,738
Information on outcome and ending date of contest available	SDC	324	6,414
Contest shorter than 252 trading days	SDC	264	6,150
Final sample			6,150

Table 2
Sample size, offer premium, markup, and runup, by year

The table shows the mean and median offer premium, markup, target stock-price runup and net runup for the sample of 6,150 initial control bids for U.S. publicly traded target firms in 1980-2008. The premium is $(OP/P_{-42}) - 1$, where OP is the price per share offered by the initial control bidder and P_i is the target stock price on trading day i relative to the takeover announcement date ($i = 0$), adjusted for splits and dividends. The markup is $(OP/P_{-2}) - 1$, the runup is $(P_{-2}/P_{-42}) - 1$ and and the net runup is $(P_{-2}/P_{-42}) - (M_{-2}/M_{-42})$, where M_i is the value of the equal-weighted market portfolio on day i.

	Sample size	Offer premium $\frac{OP}{P_{-42}} - 1$		Markup $\frac{OP}{P_{-2}} - 1$		Runup $\frac{P_{-2}}{P_{-42}} - 1$		Net runup $\frac{P_{-2}}{P_{-42}} - \frac{M_{-2}}{M_{-42}}$	
Year	N	mean	median	mean	median	mean	median	mean	median
1980	10	0.70	0.69	0.53	0.34	0.15	0.19	0.10	0.12
1981	35	0.60	0.48	0.40	0.36	0.15	0.13	0.16	0.14
1982	48	0.53	0.48	0.34	0.32	0.15	0.10	0.13	0.09
1983	58	0.49	0.50	0.33	0.35	0.12	0.12	0.10	0.08
1984	115	0.51	0.43	0.45	0.32	0.07	0.05	0.06	0.06
1985	161	0.40	0.34	0.26	0.22	0.11	0.10	0.08	0.06
1986	209	0.40	0.36	0.26	0.23	0.12	0.09	0.08	0.06
1987	202	0.39	0.36	0.32	0.25	0.07	0.07	0.06	0.03
1988	270	0.56	0.47	0.35	0.29	0.15	0.10	0.12	0.08
1989	194	0.54	0.43	0.39	0.30	0.11	0.07	0.07	0.03
1990	103	0.53	0.49	0.49	0.41	0.05	-0.00	0.05	-0.01
1991	91	0.55	0.46	0.40	0.33	0.12	0.09	0.08	0.05
1992	106	0.57	0.51	0.40	0.35	0.13	0.08	0.11	0.08
1993	146	0.48	0.43	0.36	0.33	0.10	0.07	0.08	0.05
1994	228	0.44	0.42	0.34	0.31	0.08	0.07	0.07	0.07
1995	290	0.47	0.39	0.33	0.27	0.11	0.09	0.06	0.04
1996	319	0.40	0.37	0.27	0.24	0.11	0.07	0.07	0.04
1997	434	0.41	0.38	0.26	0.23	0.13	0.12	0.09	0.08
1998	465	0.46	0.37	0.37	0.26	0.08	0.07	0.05	0.03
1999	496	0.55	0.45	0.37	0.30	0.15	0.11	0.12	0.08
2000	415	0.53	0.45	0.38	0.34	0.13	0.06	0.12	0.08
2001	270	0.55	0.46	0.40	0.34	0.11	0.08	0.12	0.09
2002	154	0.52	0.36	0.42	0.32	0.09	0.03	0.12	0.06
2003	189	0.47	0.34	0.30	0.23	0.13	0.08	0.09	0.05
2004	195	0.30	0.26	0.24	0.21	0.06	0.04	0.03	0.02
2005	230	0.30	0.27	0.25	0.21	0.05	0.04	0.04	0.03
2006	258	0.31	0.27	0.25	0.21	0.05	0.03	0.03	0.02
2007	284	0.31	0.28	0.29	0.23	0.02	0.02	0.00	0.00
2008	175	0.34	0.30	0.40	0.34	-0.04	-0.04	0.01	0.00
Total	6,150	0.45	0.38	0.33	0.27	0.10	0.07	0.08	0.05

Table 3
Description of toeholds purchased in the target firm

The table shows toehold acquisitions made by the initial control bidder, a rival control bidder, and other investors. Stake purchases are identified from records of completed partial acquisitions in SDC. The initial control bid is announced on day 0. The sample is 6,150 initial control bids for U.S. publicly traded targets, 1980-2008.

		Target stake announced in window			Total toehold on day 0
		[-126,0]	[-42,0]	[-1,0]	
A: Toehold acquired by initial control bidder					
Number of toehold purchases		136	104	70	
Number of firms in which at least one stake is purchased		122	94	63	648
In percent of target firms		2.0%	1.5%	1.0%	10.5%
Size of toehold (% of target shares) when toehold positive:	mean	12.2%	11.7%	12.7%	15.5%
	median	9.9%	9.3%	9.4%	9.9%
B: Toehold acquired by rival control bidder					
Number of toehold purchases		7	3	1	
Number of firms in which at least one stake is purchased		6	3	1	
In percent of target firms		0.1%	0.05%	0.02%	n/a
Size of toehold (% of target shares) when toehold positive:	mean	9.4%	7.0%	4.9%	
	median	9.1%	6.2%	4.9%	
C: Toehold acquired by other investor					
Number of toehold purchases		235	85	18	
Number of firms in which at least one stake is purchased		196	73	15	
In percent of target firms		3.2%	1.2%	0.2%	n/a
Size of toehold (% of target shares) when toehold positive:	mean	6.8%	8.7%	10.1%	
	median	5.4%	6.3%	7.6%	

Table 4
The market runup as a determinant of the initial offer premium

The table shows OLS coefficient estimates in regressions with target net runup ($V_{RT}-T$) and the initial offer premium V_{PT}, respectively, as dependent variables. Market rationality implies [Eq. (11) in the text]:

$$V_{PT} = \frac{1}{\pi(s)}[V_{RT} - T] + T.$$

T is the target stand-alone value change in the runup period (measured here as the market return M_{-2}/M_{-42}), the net runup $V_{RT} - T$ is $(P_{-2}/P_{-42}) - (M_{-2}/M_{-42})$, and the offer premium V_{PT} is $(OP/P_{-42}) - 1$, where P_i is the target stock price and M_i is the value of the equal-weighted market portfolio on trading day i relative to the initial control bid date. OP is the initial offer price. Sample of 6,100 initial control bids for public US targets, 1980-2008, with a complete set of control variables (defined in Table 5). p-values in parentheses.

Dependent variable:	Target net runup $\frac{P_{-2}}{P_{-42}} - \frac{M_{-2}}{M_{-42}}$		Initial offer premium $\frac{OP}{P_{-42}} - 1$			
Intercept	0.116 (0.000)	0.282 (0.012)	0.616 (0.000)	1.073 (0.000)	0.494 (0.000)	0.778 (0.000)
Market runup			0.924 (0.000)	1.054 (0.000)	0.815 (0.000)	0.926 (0.000)
Net runup					1.077 (0.000)	1.068 (0.000)
Target characteristics						
Target size	-0.015 (0.000)	-0.012 (0.000)	-0.054 (0.000)	-0.048 (0.000)	-0.039 (0.000)	-0.035 (0.000)
NYSE/Amex	0.007 (0.330)	0.003 (0.650)	0.017 (0.239)	0.011 (0.442)	0.010 (0.422)	0.008 (0.529)
Turnover	0.000 (0.754)	0.000 (0.986)	-0.001 (0.561)	0.000 (0.775)	0.001 (0.589)	0.000 (0.698)
$52-week\ high$	-0.042 (0.000)	-0.029 (0.018)	-0.214 (0.000)	-0.175 (0.000)	-0.169 (0.000)	-0.146 (0.000)
Bidder characteristics						
Acquirer public	0.032 (0.000)	0.032 (0.000)	0.046 (0.001)	0.052 (0.000)	0.012 (0.305)	0.018 (0.136)
Horizontal	-0.015 (0.036)	-0.013 (0.065)	-0.009 (0.536)	-0.002 (0.891)	0.007 (0.555)	0.012 (0.324)
Toehold size	-0.001 (0.002)	-0.002 (0.000)	-0.003 (0.000)	-0.004 (0.000)	-0.002 (0.014)	-0.002 (0.004)
Stake bidder	0.050 (0.043)	0.056 (0.024)	-0.029 (0.560)	-0.012 (0.804)	-0.082 (0.051)	-0.072 (0.088)
Stake other	0.125 (0.000)	0.126 (0.000)	0.089 (0.100)	0.093 (0.084)	-0.044 (0.340)	-0.040 (0.382)
Deal characteristics						
Tender offer	0.037 (0.000)	0.028 (0.000)	0.094 (0.000)	0.076 (0.000)	0.055 (0.000)	0.046 (0.001)
All cash	-0.009 (0.209)	0.000 (0.948)	-0.024 (0.112)	-0.002 (0.914)	-0.014 (0.278)	-0.001 (0.949)
All stock	0.003 (0.725)	0.000 (0.976)	-0.005 (0.755)	-0.008 (0.631)	-0.007 (0.600)	-0.008 (0.578)
Hostile	-0.009 (0.521)	-0.011 (0.425)	-0.005 (0.865)	-0.008 (0.773)	0.005 (0.825)	-0.004 (0.874)
Year fixed effects	no	yes	no	yes	no	yes
Adjusted R^2	0.025	0.038	0.077	0.092	0.339	0.346
$F-value$	13.1	6.86	37.4	15.7	209.2	76.0

Table 5
Variable definitions

Variable definitions. All stock prices P_i are adjusted for splits and dividends, where i is the trading day relative to the date of announcement ($i = 0$), and, if missing, replaced by the midpoint of the bid/ask spread.

Variable	Definition	Source
A. Target characteristics		
Target size	Natural logarithm of the target market capitalization in $ billion on day -42	CRSP
Relative size	Ratio of target market capitalization to bidder market capitalization on day -42	CRSP
NYSE/Amex	The target is listed on NYSE or Amex vs. NASDAQ (dummy)	CRSP
Turnover	Average daily ratio of trading volume to total shares oustanding over the 52 weeks ending on day -43	CRSP
Poison pill	The target has a poison pill (dummy)	SDC
52-week high	Change in the target stock price from the highest price P_{high} over the 52-weeks ending on day -43, $P_{-42}/P_{high} - 1$	CRSP
B. Bidder characteristics		
Toehold	The acquirer owns shares in the target when announcing the bid (dummy)	SDC
Toehold size	Percent target shares owned by the acquirer when announcing the bid	SDC
Stake bidder	The initial bidder buys a small equity stake in the target during the runup period through day 0 (dummy)	SDC
Stake other	Another investor buys a small equity stake in the target during the runup period theorugh day 0 (dummy)	SDC
Acquirer public	The acquirer is publicly traded (dummy)	SDC
Horizontal	The bidder and the target has the same primary 4-digit SIC code (dummy)	SDC
>20% new equity	The consideration includes a stock portion which exceeds 20% of the acquirer's shares oustanding (dummy)	SDC
C. Contest characteristics		
Premium	Bid premium defined as $(OP/P_{-42}) - 1$, where OP is the offer price.	SDC,CRSP
Markup	Bid markup defined as $(OP/P_{-2}) - 1$, where OP is the offer price.	SDC,CRSP
Runup	Target raw runup defined as $(P_{-2}/P_{-42}) - 1$	CRSP
Net runup	Target net runup defined as $(P_{-2}/P_{-42}) - (M_{-2}/M_{-42})$, where M_i is the value of the equal-weighted market portfolio on day i.	CRSP
Market runup	Stock-market return during the runup period defined as $M_{-2}/M_{-42} - 1$, where M_i is the value of the equal-weighted market portfolio on day i.	CRSP
Tender offer	The initial bid is a tender offer (dummy)	SDC
All cash	Consideration is cash only (dummy)	SDC
All stock	Consideration is stock only (dummy)	SDC
Hostile	Target management's response is hostile vs. friendly or neutral (dummy)	SDC
Initial bidder wins	The initial bidder wins the contest (dummy)	SDC
1990s	The contest is announced in the period 1990-1999 (dummy)	SDC
2000s	The contest is announced in the period 2000-2008 (dummy)	SDC

Table 6
Linear and nonlinear projections of markups ($V_P - V_R$) on runups (V_R)

Market rationality implies [Eq. (3) in the text]:

$$V_P - V_R = \frac{1-\pi(s)}{\pi(s)} V_R,$$

where $\pi(s)$ is the probability of a takeover bid conditional on the synergy signal s in the runup period. The linear projections is a simple OLS regression of the markup on the runup. The nonlinear projection is

$$Markup = \alpha + \beta[(r - min)^{(v-1)}(max - r)^{w-1}/\Lambda(v,w)(max - min)^{v+w-1}] + \epsilon,$$

where $\Lambda(v,w)$ is the beta distribution with shape parameters v and w, r is the runup, max and min are respectively the maximum and minimum runups in the data, α is an overall intercept, β is a scale parameter, and ϵ is a residual error term. The projection uses as starting values $v = 1, w = 2$ (for which the beta density is linear downward sloping) and the OLS estimates of a and b (for α and β), followed by a least squares fit over all four parameters to identify a best non-linear shape. For all of the projections in this table, the resulting form of the non-linearity corresponds closely to that shown in Figure 6 for projection (1), and are thus consistent with the general concave then convex shape shown in the theoretical Figure 3. First-order residual serial correlation is calculated after ordering the data by runup. Using the t-statistic (in parentheses), a significant positive residual serial correlation rejects the hypothesis that the true projection is linear and is consistent with deal anticipation driving a portion of the runup.

	N	Markup measure $V_P - V_R$	Runup measure V_R	Linear projection $V_P - V_R = a + bV_R$	Linear residual serial correlation	Nonlinear residual serial correlation
(1)	6,150	Total markup $\frac{OP}{P_{-2}} - 1$	Total runup $\frac{P_{-2}}{P_{-42}} - 1$	$a = 0.36$ $b = -0.24$ (-11.9)	0.030 (2.36)	0.015 (1.15)
(2)	5,035[a]	Total markup $\frac{OP}{P_{-2}} - 1$	Total runup $\frac{P_{-2}}{P_{-42}} - 1$	$a = 0.36$ $b = -0.22$ (-10.1)	0.045 (3.21)	0.027 (2.19)
(3)	6,103	Expected markup[b] $\pi[\frac{OP}{P_{-2}} - 1]$	Total runup $\frac{P_{-2}}{P_{-42}} - 1$	$a = 0.31$ $b = -0.17$ (-9.5)	0.027 (2.11)	0.016 (1.25)
(4)	6,150	Residual markup[c] U_P	Augmented runup[d] $(\frac{P_{-2}}{P_{-42}} - 1) + R_0$	$a = 0.36$ $b = -0.21$ (-12.1)	0.052 (4.03)	0.031 (2.45)
(5)	6,150	Market Model[e] $CAR(-1,1)$	Market Model[e] $CAR(-42,-2)$	$a = 0.22$ $b = -0.09$ (-6.7)	0.039 (3.10)	0.038 (2.95)

[a] This projection is for the subsample where the initial bid in the contest ultimately leads to a control change in the target (successful targets).

[b] This projection is for the subsample with available data on the target–, bidder– and deal characteristics used to estimate the probability π of bid success in Table 7. The projection includes the effect of these variables by multiplying the total markup with the estimated value of π.

[c] Residual markup, U_P, is the residual from the projection of the total markup, $\frac{OP}{P_{-2}} - 1$, on the deal characteristics used to estimate the success probability π in Table 7, excluding *Positive toehold*, *Toehold size*, and $52 - week\ high$ which are used to construct the augmented runup. Variable definitions are in Table 5.

[d] The enhancement R_0 in the augmented runup adds back into the runup the effect of information that the market might use to anticipate possible takeover activity *prior* to the runup period. R_0 is the projection of the total runup $(\frac{P_{-2}}{P_{-42}} - 1)$ on the deal characteristics *Positive toehold*, *Toehold size*, and the negative value of $52 - week\ high$, all of which may affect the prior probability of a takeover (prior to the runup period). The augmented runup is the total runup plus R_0. Variable definitions are in Table 5.

[e] Target cumulative abnormal stock returns (CAR) are computed using the estimated Market Model parameters: $r_{it} = \alpha + \beta r_{mt} + u_{it}$, where r_{it} and r_{mt} are the daily returns on stock i and the value-weighted market portfolio, and u_{it} is a residual error term. The estimation period is from day -297 to day -43 relative to the day of the announcement of the initial bid.

Table 7
Probability of contest success

The table shows coefficient estimates from logit regressions for the probability that the contest is successful (columns 1-2) and that the initial control bidder wins (columns 3-6). P-values are in parenthesis. The sample is 6,103 initial control bids for public US targets, 1980-2008, with a complete set of control variables (defined in Table 5).

Dependent variable:	Contest successful		Initial control bidder wins			
Intercept	1.047	0.909	0.657	0.455	0.626	0.437
	(0.000)	(0.000)	(0.000)	(0.005)	(0.000)	(0.007)
Target characteristics						
Target size	0.137	0.085	0.148	0.094	0.150	0.096
	(0.000)	(0.005)	(0.000)	(0.001)	(0.000)	(0.001)
NYSE/Amex	-0.365	-0.269	-0.435	-0.330	-0.433	-0.329
	(0.000)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	-0.017	-0.019	-0.017	-0.019	-0.017	-0.019
	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)
Poison pill	-0.578	-0.513	-0.506	-0.436	-0.406	-0.341
	(0.028)	(0.053)	(0.063)	(0.114)	(0.138)	(0.219)
$52-week\ high$	1.022	1.255	0.864	1.117	0.868	1.120
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bidder characteristics						
Toehold	-0.819	-0.688	-0.978	-0.833	-1.589	-1.419
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Toehold size					0.039	0.038
					(0.000)	(0.000)
Acquirer public	0.833	0.804	0.938	0.900	0.952	0.915
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Horizontal	0.248	0.211	0.276	0.226	0.281	0.232
	(0.020)	(0.050)	(0.006)	(0.025)	(0.005)	(0.022)
$>20\%$ *new equity*	-0.585	-0.577	-0.531	-0.522	-0.536	-0.526
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Premium	0.343	0.371	0.334	0.365	0.350	0.380
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Deal characteristics						
Tender offer	2.173	2.307	1.912	2.053	1.945	2.085
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash	-0.148	-0.276	-0.105	-0.224	-0.114	-0.236
	(0.119)	(0.005)	(0.236)	(0.014)	(0.199)	(0.010)
Hostile	-2.264	-2.149	-3.086	-2.980	-2.994	-2.893
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1990*s*		0.435		0.566		0.548
		(0.000)		(0.000)		(0.000)
2000*s*		0.775		0.824		0.816
		(0.000)		(0.000)		(0.000)
Pseudo-R^2 (Nagelkerke)	0.208	0.219	0.263	0.276	0.269	0.281
χ^2	755.1	795.8	1074.0	1129.3	1098.5	1151.8

Table 8
Projections of bidder returns (ν_P) on target runup (V_R)

The table shows OLS estimates of bidder cumulative abnormal returns $\nu_P = BCAR(-42, 1)$, from a market model estimated over day -297 through -43. All regressions control for year fixed effects. The p-values (in parenthesis) use White's (1980) heteroscedasticity-consistent standard errors. Total sample of initial control bids by U.S. public bidders, 1980-2008.

	Regression model					
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.116 (0.091)	-0.116 (0.102)	-0.110 (0.979)	-0.114 (0.102)	-0.097 (0.486)	-0.099 (0.288)
Total Target Runup $V_R = \frac{P_{-2}}{P_{-42}} - 1$	0.049 (0.006)	0.054 (0.003)				
Net Target Runup[a] $V_{RT} = \frac{P_{-2}}{P_{-42}} - \frac{M_{-2}}{M_{-42}}$			0.078 (0.000)	0.082 (0.000)		
Augmented Target Runup[b] $V_R = (\frac{P_{-2}}{P_{-42}} - 1) + R_0$					0.049 (0.006)	
Market Model Target Runup[c] $V_{RT} = CAR(-42, 2)$						0.148 (0.000)
Control variables[d]	no	yes	no	yes	no	no
Adjusted R^2	0.019	0.025	0.019	0.049	0.043	0.049
Sample size, N	3,691	3,689	3,660	3,691	3,624	3,623

[a] $\frac{M_{-2}}{M_{-42}}$ is the return on the equal-weighted market portfolio in the runup period (from day -42 to day -2).

[b] The enhancement R_0 in the augmented runup adds back into the runup the effect of information that the market might use to anticipate possible takeover activity *prior* to the runup period. R_0 is the projection of the total runup $(\frac{P_{-2}}{P_{-42}} - 1)$ on the deal characteristics *Positive toehold, Toehold size*, and the negative value of $52 - week\ high$, all of which may affect the prior probability of a takeover (prior to the runup period). The augmented runup is the total runup plus R_0. Variable definitions are in table 5.

[c] Target cumulative abnormal stock returns (CAR) are computed using the estimated Market Model parameters: $r_{it} = \alpha + \beta r_{mt} + u_{it}$, where r_{it} and r_{mt} are the daily returns on stock i and the value-weighted market portfolio, and u_{it} is a residual error term. The estimation period is 252 trading days prior to day -42 relative to the day of the announcement of the initial bid.

[d] There are three categories of control variables. (1) Target characteristics: *Relative size*, *NYSE/Amex*, and *Turnover*. (2) Bidder characteristics: *Toeholdsize* and *Horizontal*.(3) Deal characteristics: *All cash*, *All stock*, and *Hostile*. See Table 5 for variable definitions. Of these variables, *Relative size* and *All cash* receive significantly positive coefficients, while *Turnover* receives a significantly negative coefficient. The remaining control variables are all insignificantly different from zero.