The Hubris Hypothesis:
Empirical Evidence

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ABSTRACT
The Hubris Hypothesis is grounded on a failure to adequately account for the winner's curse, which leads to overbidding. Surprisingly few papers have attempted to develop a direct empirical test of the presence of overbidding in M&A contests. We develop two such tests in this paper. Our results strongly support the existence of overbidding.

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Introduction

The Hubris Hypothesis of Corporate Takeovers[1] provides a potential explanation of the observed negative acquirer cumulative abnormal returns (CAR) reported around mergers and acquisitions (M&A) announcements at that time[2]. The explanation combines bidding competition and valuation error. During the takeover contest, bidders compete to acquire the target. The winner posts the highest bid. Because bids increase with assessments of value, the winning bidder generally has one of the highest valuations. Being the winner indicates that other bidders have a lower valuations. In an interdependent value setup, which is the relevant one for economic goods (economic goods can always be resold), this is bad news for the winner. Participants to the takeover contests should rationally anticipate this winners' curse and shade their bids accordingly. If they do not, the ex-post observed value-effect of acquiring the target may be negative because winning the contest reveals overbidding[3,4].

Numerous empirical papers continue to report negative acquirer CARs (see Betton et al., 2008, for an extensive literature review of M&A research). But negative acquirer CARs are not unambiguous proof of overbidding. Acquisition announcements deliver information not only about the transaction itself but also about the acquirer's current condition and strategy. Akdogu (2011), for example, emphasizes that acquisitions can be undertaken as a response to competitive pressures of which the

[1] Roll (1986)

[2] In 1986, Jensen and Ruback (1983) was the most widely-read literature review about M&A value effects. These authors summarize previous studies reporting negative CAR for acquirers. At that time, existing empirical studies had rather small samples of a few hundred large transactions. Since then, newer investigations have been able to study far larger numbers of transactions (e.g., Fuller et al., 2002). These studies show that the negative acquirer CAR is observed mainly when the target is a publicly traded firm. This accords with the Hubris idea that the observed market price of a target is an accurate estimate of value.

[3] When the target is a publicly traded company, the established market price already represents a de facto bid, so an acquirer must have a valuation exceeding the market price. Even if there is only one acquirer (in addition to the market), the winner's curse could still have an impact.

[4] Overbidding may in fact find its roots either in bidder irrationality (the bidder fails to anticipate the winners' curse) or in decision delegation from shareholders to CEOs, the classic agency conflict studied in Jensen and Meckling (1976). Agency conflicts potentially play a significant role in the case of M&A decisions because CEOs are known to be key decision makers in the acquisition decision process (Harding and Rovit, 2004). CEOs may pursue other goals then shareholder value maximization, e.g. private benefits (Mork et al., 1990), or simply be more risk averse than shareholders and seek diversification (Becker, 2006). In both cases, overbidding leads to shareholder value destruction.

market is unaware prior to the bid. In such a circumstance, a negative acquirer CARs is compatible with a value creating transaction because, in the absence of transaction, the acquirer would have been even worse off. And positive acquirer CARs are not irrefutable evidence of rational (shareholders value maximizing) bidding either. Even if CEOs undertake transactions that create value for their shareholders, they may bid so that value creation is less than optimal. For example, there might be substantial synergies in a particular proposed merger but the acquirer might give up too much of them to the target. Testing overbidding is therefore inherently challenging; this explains probably the limited number of empirical studies addressing the issue. Moeller et al. (2004) and Boone and Mulherin (2008) report evidence failing to support the winners' curse predictions. But other contributions report results compatible with, or even supporting, the Hubris Hypothesis (Berkovitch and Narayanan, 1993; Muller and Sirower, 2003; Eckbo and Thorburn, 2009)[5]. The debate is clearly still open.

Our paper develops two direct tests of overbidding. The first test involves the first order condition (FOC) of a bidder[6]'s expected profit maximization. Expected profit equals the probability of a successful acquisition multiplied by bidder's profit conditional on acquisition. The probability of success is increasing in the bid premium while profits conditional on success are decreasing in it. Shareholders' value maximizing acquirers select the optimal bid premium by trading off these two effects. Therefore, if the bid premium is guided by value maximization, the derivative of acquirer expected profits with respect to the bid premium should be in ex-post and on average equal to zero because this is the maximization program FOC.

Implementing the test is however challenging for two reasons. First, the probability of success is not observable. Second, using the ex-post observed outcome is not an option in our case. Bids are chosen endogenously based on a prior assessment of success. Thus, a high bid premium could

[5] Malmendier and Lee (2011) report also clear evidences of irrational bidding in the context of online auctions, due to limited attention.

[6] We adopt the bidder denomination in the paper because our sample contain successful and unsuccessful deals

conceivably be positively associated ex-post with a high failure rate. We rely on two proxies for the probability of success. Our first proxy for success probability is based on a first stage probit model using a large set of publicly observable determinants. The second is a measure of the difference between the bid premium and the observed price reaction around the announcement. The larger this difference, the less investors believe that the M&A attempt will be successful. While we are aware that both proxies suffer from shortcomings, we believe that they are at a minimum positively correlated with the unobservable true probability of success. Our test is constructed so that the weaker are these proxies, the less likely it will reject rational bidding. The test is therefore conservative. The second challenge that we have to address is the clearly endogenous relation between the probability of success and bidder returns, both being the outcome of the acquirer's expected profit maximization program. We estimate a system of two simultaneous equations using the three stage least squares (3SLS) estimator to address this issue. Identification is possible thanks to information collected, a.o., in SEC filings (in particular, deal initiation and sales process). The test of the FOC of the acquirer's expected profit maximization is then a test of a cross-equation restriction evaluated at estimated coefficients.

Our empirical results rely on a sample of 977 acquisition attempts between U.S. listed bidders and targets, during the period 1994 to 2007. The average deal size is USD 2,839 million. The average three day bidder CAR is -2.80% (strongly affected by the internet bubble period) and the average four-week bid premiums is 38.72%, similarly to results reported in previous studies for public target takeover contests; see Betton et al., 2008). Ninety five percent of these acquisition attempts are successful.

For each observation, we compute the three day bidder CAR (using the standard market model as return generating process) and our two proxies of the probability of success. We collect a large set of previously-studied determinants of bidder CAR and success probability from the CRSP, Compustat and SDC databases. We complement this standard set of control variables by measures of deal initiation and

sales process. These hand-collected SEC filing items play a central role in our testing strategy because they allow identification of our simultaneous equations system.

Our results strongly reject that, on average, observed bids comply with the bidder's expected profit maximization FOC. We confirm this result using two proxies of the probability of success, the two stage least squares (2SLS) estimator and the eight-week bid premium in place of the four-week bid premium. Statistical significance exceeds the 1% threshold in most tests. Our first test suggests therefore a significant presence of overbidding behavior among bidders in takeover contests.

Our second test of irrational bidding is designed to overcome constraints on sample size due to hands collection of data and potential mis-specifications due to the unobservable nature of the probability of success. The test intuition is based on the information set used by bidders to determine their bidding strategy. Auction theory teaches us that the fundamental determinant of the equilibrium bidding strategy, which condition bidder expected profits, is the bidder valuation (Krishna, 2010). In the M&A context, the bidder valuation is the addition of the target current value and the expected synergies. For listed targets, the current value is common knowledge[7]. The driving force of the bidder's profit is therefore the expected synergies. Once expected synergies are taken into account, the bid premium itself should contain no additional information about the bidder's profit.

We test this rational bidding prediction by regressing the bidder CAR (the bidder's profit proxy) on the deal CAR (the deal synergies proxy), that we instrument with the average industry deal CAR in robustness checks, and the bid premium. If the driving force of bidder bidding strategy is the deal synergies, adding the bid premium to the regression should be irrelevant. We expect therefore the coefficient of the bid premium to be equal to zero under the rational bidding hypothesis. The strengths of this approach are clear. Data requirements are limited because no identification issues impose the use of hand-collected data to find valid instruments. Therefore, standard electronic databases can be used.

[7] it is the market value observed when there is no likelihood of an acquisition because the target can be sold at that price in the absence of acquisition related synergy anticipations

Moreover, we no longer require a proxy for the probability of success. The test is thus free of potential mis-specifications at that level. Our second approach is however exposed to the classical endogenous omitted variables problem. A clear example is the role of competition. The presence of rival bidders is clearly correlated with both deal synergies and the bid premium. The solution is to include many relevant control variables, but there is always the possibility that something is overlooked.

Thanks to the low data requirements of our second test, we are able to gather a sample of 2,730 completed transactions for 1986 through 2008 between U.S. listed bidders and targets, for which the deal size is at least USD 1 million and the bidder seeks full control of the target. The average deal size is USD 1,402 million, significantly lower than for our first sample. The average bidder CAR is – 1.34%, significantly less negative than in our first sample, as expected for a sample encompassing smaller transactions (see Betton et al., 2008). The average four-week bid premium is 42.48%.

Regressing the bidder CAR on the deal CAR and the bid premium generates a negative and highly significant coefficient for the bid premium variable. This is true for both definitions of the bid premium (four-week and eight-week bid premium). We also obtain qualitatively the same results when instrumenting the deal CAR with the average industry deal CAR in the same year. As a last validity check, we replicate our second test on the small sample used to implement our first test and obtain consistent results. After controlling for the value creation, bidders who increase their bid take detrimental decisions. The result is again consistent with the presence of overbidding.

Our two tests deliver the same message: overbidding in takeover contests is <u>not</u> a theoretical construct. Bidding behavior that we observe empirically confirms clearly that the average bidder bids more than the amount that maximizes shareholder value.

Finally, we provide a first exploration of the determinants of overbidding. We first focus on agency conflicts sources of overbidding. The literature suggests several proxies for this source of divergence between shareholders and CEOs goals. We focus on the following seven attributes of the

bidder: (a) past performance (Rau and Vermaelen, 1998), (b) CEO variable compensation (Grinstein and Hribar, 2004), (c) the Gompers, Ishii and Metrick (2003) index (GIM), (d) free cash-flow (Jensen, 1986), (e) leverage (Jensen and Meckling, 1976), (f) CEO age and tenure (Yim, 2012) and (g) the CEO pay-slice (Bebchuk and al., 2011). In a sub-sample of 544 deals for which we are able to collect these attributes, we find that overbidding increases with past performance (past successes may lead to overestimating future ones), CEO variable compensation (CEOs capture bonuses thanks to acquisitions) and the GIM index (entrenched CEOs are less subject to be fired in case of value destruction) while it decreases with leverage (leverage is an agency relation control mechanism), CEO age (age is correlated with risk aversion) and the CEO pay slice. We next study overbidding behavior around the internet bubble episode, implementing a differences-in-differences test. The internet bubble burst can be interpreted as a significant exogenous shock to acquirer overconfidence in high-technology industries (a quasi-experiment with respect to our research question) and potentially provide an interesting setup to explore the role of irrationality in overbidding behavior. Our results confirm that overbidding dropped significantly more in high-technology industries relative to other industries, as expected.

Our paper contributes to different streams of literature. The first is behavioral corporate finance. Roll (1986) introduced the possibility that irrational behavior could lead to poor corporate performances. A large body of literature developed in the wake of this intuition. In the M&A field, the setup of the Roll (1986) paper, Hayward and Hambrick (1997), Chatterjee and Hambrick (2007), Malmendier and Tate (2008), Aktas et al. (2014) study respectively the role of hubris, narcissism and overconfidence. Overbidding behavior must be observed empirically for these psychological biases to affect acquisition shareholder value creation. The second research field to which our results contribute is auction theory and its applications. The winners' curse has been subject to extensive analyses (Krishna, 2010). In the absence of overbidding behavior, its relevance could be questioned. By showing that overbidding affects the M&A market, a fundamental resources allocation mechanism in the economy, we confirm that the

winner's curse is a potential candidate to explain irrational bidding behavior here also. The third stream to which our paper contributes is the M&A literature itself. Value creation and its repartition between bidders and targets have been central issues for more than 30 years (Betton et al., 2008). Overbidding directly affects the sharing of values between parties, whether it originates from irrationality or agency conflicts. Because ex-post we observe winners of takeover contests, those who are the most likely bidding beyond reason, and because overbidding behavior is conceivably correlated with other bidder characteristics, ignoring the existence of overbidding may lead to erroneous interpretation of empirical findings.

We structure our paper in three sections. The two firsts are dedicated to our two tests of overbidding. We explore in the third one potential determinants of overbidding. We then conclude.

Section 1 – The bidder's expected profit maximization

We first motivate our testing strategy. We then describe its implementation. We finally report our results and complementary robustness checks.

1.1. Shareholders' value maximizing bidding behavior

In the absence of irrational behavior and/or agency conflicts, the CEO will choose an equilibrium bidding strategy to acquire the target in order to maximize shareholders' value creation. The CEO maximization program takes the following form:

$$\max E_{Bid}(Bidder's\ Profit) = \left(\Pr\left(Success\right) \times E(Synergies - Bid|Success)\right) \qquad (1)$$

where $E(\,)$ stands for expectation, $\Pr(\,)$ for probability, $E(\,|\,)$ for conditional expectation and Bid, for the bid premium. The bidder's profit is the transaction specific value creation. Success indicates that the

deal will be completed. Synergies designate value created specifically thanks to the acquisition and any economic benefits that accrue to the acquirer, such as pressure put on competitors (Akdogu,2011); and bid is the target shareholders payment in case of success, whatever the form. The corresponding first order condition is:

$$\frac{\partial\, E(Bidder's\ Profit)}{\partial\, Bid} = \frac{\partial \Pr(Success)}{\partial\, Bid} \times \Big(E\big(Synergies - Bid \big| Success\big)\Big) + \frac{\partial E(Synergies - Bid|Success)}{\partial\, Bid} \times \big(\Pr(Success)\big) = 0 \quad (2)$$

We propose to test Equation (2) as a necessary condition for shareholders' value maximizing bidding behavior. The test rests on $\frac{\partial \Pr(Success)}{\partial\, Bid}$ and $\frac{\partial E(Synergies - Bid|Success)}{\partial\, Bid}$, the partial derivatives of the probability of success with respect to the bid and the partial derivatives of the bidder's profit conditionally on successful acquisition, also with respect to the bid. These two partial derivatives need to be estimated. Irrational bidding originating from not taking into account the winner's curse affects both the probability of success, if other bidders don't display the same degree of irrationality, and the bid itself. Deviations from the Equation (2) can also be caused by agency related motives.

We now describe our econometric specification, noting that bidder's profit and probability of success are fundamentally endogenous.

1.2. Econometric specification

The test of Equation (2) is based on the following simultaneous equations system estimation:

$$Bidder's\ Profit = a_0 + a_1 \times Bid + a_2 \times Synergies + a_3 \times \Pr(Success) + Control\ Variables + \varepsilon_1 \quad (3)$$

$$\Pr(Success) = \beta_0 + \beta_1 \times Bid + \beta_2 \times Initiation + \beta_3 \times Negotiation + \beta_4 \times Bidder's\ Profit + Control\ Variables + \varepsilon_2 \quad (4)$$

where ε_1 and ε_2 are regression errors. We use the variables $Synergies$, $Initiation$ (the party who initiates the transaction) and $Negotiation$ (the form of the sales process) to meet the order conditions for identification. More specifically, we assume that $Synergies$ impact $Bidder's\ Profit$ (Antoniou et al. (2008) show that deal CAR and bidder CAR are indeed positively correlated). $Synergies$ will however affect $\Pr(Success)$ only through $Bidder's\ Profit$. This exclusion is supported by results reported, a.o., by Luo (2005). The author shows that potential acquirers observe their own CAR around M&A announcement and that the probability of dropping the acquisition attempt increases in case of negative reaction. $Initiation$ and $Negotiation$ influence directly $\Pr(Success)$. When a firm put itself for sale, it is no surprise that the probability that an acquisition will effectively take place increases significantly (de Bodt et al., 2014). We also expect that friendly negotiations lead to completion more frequently; (Betton et al. (2014) show that hostility negatively impacts the probability of deal success). These two variables will affect $Bidder's\ Profit$, but our exclusion restrictions assume that it is through $\Pr(Success)$ and not directly. Masulis and Simsir (2013) and Boone and Mulherin (2008) show in particular that, respectively, initiation and the sales process has no significant direct effect on bidder CAR.

We estimate the Equations (3) and (4) simultaneously using the 3SLS estimator (and, in robustness checks, 2SLS, because it is robust to potential mis-specification of one of the two equations). $\hat{\alpha}_1$ is our estimate of $\frac{\partial E(Synergies-Bid|Success)}{\partial\ Bid}$ [8] and $\hat{\beta}_1$, of $\frac{\partial \Pr(Success)}{\partial\ Bid}$. We test then Equation (2) as the following cross-equations constraint:

$$\hat{\beta}_1\ \times\ \overline{Bidder\ Profit} + \hat{\alpha}_1\ \times\ \overline{\Pr(Success)} = 0 \qquad (5)$$

[8] $\hat{\alpha}$ is strictly speaking an estimate of $\frac{\partial\ bidder's\ Profit}{\partial\ Bid}$. Because $Bidder's\ Profit$ is defined as $Synergies - Bid$, $\hat{\alpha}$ and therefore an estimate of $\frac{\partial\ Synergies-Bid}{\partial\ Bid}$, and not $\frac{\partial E(Synergies-Bid|Success)}{\partial\ Bid}$. We the test the robustness of our results to conditioning the measure of bidder's profit to deal success by rescaling bidder CAR by the probability of success.

where $\overline{Bidder\ Profit}$ and $\overline{\Pr(Success)}$ are the sample mean estimates. The test follows a Chi^2 distribution with 3SLS and the $Fisher$ distribution with 2SLS.

1.3. Variables[9]

Bidder profit

Our proxy for the bidder's profit is the classic bidder CAR (we are aware that bidder CARs are possibly contaminated by other information and hence we introduce a large set of control variables to mitigate this issue). Bidder CAR are obtained using the market model (MM) return generating process, using as estimation window day minus 250 to day minus 10 with respect to the announcement date and as proxy for the market index, the CRSP value weighted index. CAR is the sum of MM residuals over a three days event window centered on the announcement date.

Probability of success

Obtaining a proxy for the probability of success is more problematic. The probability of success is not directly observable and its observed outcome makes no sense as a proxy. Even if the outcome is conceivably correlated with the probability of success, it is fundamentally endogenous to the bid premium. The bidder may optimally decide to choose a large premium when there is a high probability of failure. Consequently, the bid premium may correlate ex-post negatively with the probability of success!

We use two proxies for the probability of success. The first one is based on estimated probabilities from a probit model. We follow Betton et al. (2014) and estimate the following model:

$$\Pr(Success)_{Probit} = Probit\left(\begin{array}{c}\alpha_0 + \alpha_1\, TargetSize + \alpha_2\, NyseAmex + \alpha_3\, Turnover \\ + \alpha_4\, PoisonPill + \alpha_5\, 52WeeksHigh + \alpha_6\, Toehold + \alpha_7\, ListedBidder \\ + \alpha_8\, Horizontal + \alpha_9\, BidPremium + \alpha_{10}\, TenderOffer + \alpha_{11}\, AllCash \\ + \alpha_{12}\, AllStock + \alpha_{13}\, Hostile + \alpha_{14}\, Year1990 + \alpha_{15}\, Year2000\end{array}\right) \quad (6)$$

[9] Appendix 1 provides the precise definitions and data sources of all the variables used in the empirical analysis.

where $TargetSize$ is logarithm of the target market value estimated 42 days before the announcement date, $NyseAmex$ is dummy variable taking value 1 if the target is listed on the Nyse, $Turnover$ is average daily ratio of the target trading volume to total shares outstanding over the 52 weeks before the announcement date, $PoisonPill$ is a dummy variable taking value 1 if the target has a poison pill, $52WeeksHigh$ is the ratio of the share price 42 days before the announcement date to the maximum share price during the 52 weeks before the announcement day minus 42, $Toehold$ is a dummy variable taking value 1 if the bidder owns shares of the target before the deal announcement, $ListedBidder$ is a dummy variable taking value 1 if the bidder is a public company, $Horizontal$ is a dummy variable taking value 1 if the bidder and the target share the same 4-digits primary SIC code, $BidPremium$ is the four-week or the eight-week (depending on the specifications) bid premium, $TenderOffer$ is a dummy variable taking value 1 if the transaction is a tender offer, $AllCash$ ($AllStock$) is a dummy variable taking value 1 if the payment is 100% cash (stock), $Hostile$ is a dummy variable taking value 1 if target management responds negatively to the acquisition proposal and $Year1990$ ($Year2000$) is a dummy variable taking value 1 if the deal is announcement during the period 1990 to 1999 (2000 to 2009).

To estimate Equation (6), we collect a sample of 4,299 transactions announced during the period 1986 to 2008. The sample includes all transactions between US bidders and US listed targets, with a deal size above USD 1 million, for which the bidder held less than 50% before the acquisition attempt and more than 50% after, reported in the SDC database. Table 1 reports summary statistics by year. The end of the nineties M&A wave is clearly apparent as well as the mid of the 2000s. The average deal completion rate is 75.67% and the average four-week bid premium is 42.07% (with a corresponding median of 33.79%). Interestingly, the bid premium displays a decreasing trend during the second half of the period. The eight-week and four-week bid premiums are very close each other. These figures are in line with previously reported statistics about the US M&A market activity (see Betton et al., 2008).

Table 2 reports descriptive statistics for all the variables included in Equation (6) as well as a test of difference of means between completed and uncompleted transactions. The sample is composed of 75.67% completed transaction (see Table 1 also), 27.77% of targets listed on the NYSE, 3.4% of targets with poison pills, 12.7% of cases with toeholds, 67.04% of listed bidders, 30.15% of horizontal transactions, 18.54% of tender offers, 41.89% of pure cash deals and 26.49% of pure stock deals and 8.58% of transactions classified as hostile. The sample mimics other large samples of U.S. transactions with public targets in the existing literature (Betton et al., 2008). The average four-week bid premium is 42.07% (and the corresponding average eight-week bid premium is 41.37%), also consistent with figures reported in such samples. The ratio of the price 42 days before announcement to the 52 week maximum is -27.27%, an indication consistent with bidder market timing behavior (Baker et al., 2009). Tests of differences of means provides some interesting, but familiar, insights: in the sub-sample of completed transactions, the proportions of targets listed on the NYSE/AMEX, protected by a poison pill and in which the bidder has a toehold are smaller. All cash payments are also less frequent. The sub-sample includes higher proportions of transactions by listed bidders and of horizontal transaction. Successful transactions are more frequent during the second decade of the studied period. Completed transactions display also higher eight-week bid premium (but we observe no statistically significant difference for the four-week bid premium) and less depressed target share price with respect to the 52 weeks highest price. We note finally that it is in the completed transactions sub-sample that the target trading volume (turnover) is higher. These results are consistent with previous results reported in the literature (eg., Betton et al., 2008; Betton et al., 2014).

Table 3 displays Equation (6) estimation results. Four specifications are reported: columns (1) and (3) report results with the four-week bid premium while columns (2) and (4), with the eight-week bid premium. In columns (1) and (2), the raw bid premium is used and, as robustness check, in columns (3) and (4), bid premiums are winsorized at the one and ninety-nine percentiles. We observe first the very

high stability of our estimation results across the four specifications: all estimated coefficients keep their signs and statistical significance. The next striking result is that, while the eight-week bid premium has a positive and significant coefficient (as intuitively expected), the four-week bid premium coefficient is insignificant. The eight-week bid premium results is consistent with Betton et al. (2014), who also use an eight-week period to compute the premium. The difference of results between the eight-week and four-week bid premium may be explained by information leakages and deal anticipations. Schwert (1996) shows in particular that, on average, investors start to anticipate the transaction as soon as 42 days before the official announcement. To continue the comparison with Betton et al. (2014), we get the same coefficient signs and statistical significance for target size, target stock exchange, target turnover, target poison pill (not significant in this multivariate setup), 42 days prices before announcement to 52 weeks high prices ratio, bidder toehold, bidder status, horizontal deal, tender offer, all cash deal (not significant in this multivariate setup), hostility and transaction periods variables. Switching from the univariate (Table 2) to the multivariate (Table 3) context brings some differences. Already mentioned above is the loss of significance of the poison pill and all cash variables. We note also that the coefficient of target size becomes significant in the multivariate context.

We use estimated coefficients from Table 3 to build our probit based proxy for the probability of success.

Our second proxy for the probability of success is based on investors' anticipations. We compute it in the following way:

$$\widehat{\Pr}(Success)_{Bid} = \left(\frac{Target\ CAR}{Bid\ Premium}\right) \tag{7}$$

where $Target\ CAR$ is computed by the same procedure as bidder CAR, except that the event window goes from day minus twenty to day plus one in order to parallel the computation of the four-week bid

premium and the $Bid\ Premium$ is either the four-week or the eight-week bid premium. $\widehat{\Pr}(Success)_{Bid}$, used in Aktas et al. (2014), builds on the idea that the more investors are convinced that the probability of success is high, the higher will be the share price revision around the acquisition attempt announcement. $\widehat{\Pr}(Success)_{Bid}$ suffers potentially from two biases: rumors and anticipations of future bid revisions (either by the initial bidder or by rival ones). We use the four-week and the eight-week bid premium to test the potential impact of rumors. We acknowledge the possibly confounding influence of future bid revisions, but such anticipations are positively correlated with the probability that the target will be acquired; hence, they belong in our measure from the beginning[10]. We rescale $\widehat{\Pr}(Success)_{Bid}$ between 0 and 1, to be interpretable as a probability.

Bid premium

The four-week bid premium is collected from the SDC database. The height-week bid premium is obtained as:

$$BidPremium\ 8\ Weeks = \frac{OfferPrice}{Price_{t-42}} - 1 \quad (8)$$

The offer price is itself collected in the SDC database and the share price, in the CRSP database.

Additional control variables

In addition to variables included in Equation (6), we collect a large set of variables, from both standard electronic databases and SEC filings:

- From the CRSP, Compustat and SDC database, we compute the bidder market value ($BidderSize$), the target CAR ($TargetCAR$) and the deal CAR ($DealCAR$), our proxy for $Synergies$, using the same return generating process, estimation window and event window as

[10] One might also argue that bid revisions may originate from rival bidders. But, as reported in Betton et al. (2009), rival bidders rarely win the takeover contest (the authors report a frequency of 3.7% in a sample of 10,806 takeover contests from 1973 to 2002).

for bidder CAR. We add the target runup ($TargetRunup$) - the ratio of the target share price two days before the announcement date to the target share price forty-two days before it minus one, bidder star advisor ($BidderStarAdv$) - a dummy variable taking value one if the bidder choses as advisor one of the top six US financial advisors, ranked by the aggregate deal values of M&As into which these institutions were involved, the target to bidder relative size ($RelativeSize$), the target industry liquidity ratio ($TargetIndLiquidity$) - the average liquidity ratio (Schlingemann et al. (2002) M&A activity index) in the SIC 4-digits target industry the year of the announcement date, the target and bidder industry deal CAR ($TargetIndCAR$ and $BidderIndCA$ respectively) - the average of targets and bidders CAR for deals that occurred during the announcement date year in the same SIC 2-digits industry as respectively the target and the bidder industry and three proxies of bidder private information variation around the deal announcement, $BidderPrivateR2$, $BidderPrivateAmihud$ and $BidderPrivateRoll$ – based respectively on the residuals of the market model, the Amihud (2002) private information ratio and the Roll proxy for the spread (Roll, 1984).

- We collect in the SDC filings two variables: $Initiation$ and $Negotiation$. To obtain them, we use SEC filings DEFM 14A and S-4 for mergers and 14D for tenders offers. $Initiation$ is a dummy variable taking value one if the target initiated the transaction. We follow Boone and Mulherin (2007) to identify the sales process. $Negotiation$ takes value one in case of one to one negotiation and zero in case of (formal or informal) auction.
- We finally identify the number of bidders from the SDC and code $MultipleBidder$ as a dummy variable taking value one in case of multiple bidders contests.

1.4. M&A Sample

We test Equation (5) by collecting a sample of 977 completed and uncompleted transactions. We start from the sample used in Aktas et al. (2010). The initial sample covers the period 1994 to 2007 and contains only completed transactions. The starting 1994 year was chosen because SEC filings became available in the electronic EDGAR database that year and the ending year was chosen to exclude the 2008 financial crisis. The sample was extracted from the SDC database using the following criteria: the bidder and the target must be US listed firms, the deal size must be at least USD 100 million, the bidder must old less than 50% of the target shares before the transaction and more than 50% afterwards (in most cases, the percentage held after completion is in fact 100%) and the four-week bid premium must be available in the SDC database. The combination of these criteria generates a sample of 2,006 transactions. SEC filings collection has been possible for 1,774 transactions. This initial sample is complemented by a sample of uncompleted transactions, selected using the same combination of criteria. Transactions are considered as uncompleted if they are reported as such in the SDC database. We obtain the necessary SEC filings for 320 uncompleted transactions. Merging these two samples, we obtain therefore 2,094 transactions. We next collect the variables required for Equations (3) and (4) estimation. This lead us to a sample 977 completed and uncompleted transactions. The sample size shrinking is mainly due to the difficulty to collect initiation and sales process in many SEC filings. But, this sample size still compares favorably to sample used in many previous academic contributions using SEC filings information.

Table 4 displays descriptive statistics about this sample. The M&A wave of the late nineties is again clearly apparent. The phenomenon is exacerbated in deal value, mega M&As being observed during that periods (Moeller et al., 2005). Bidder CAR are negative (-2.8%), as expected for large transactions between listed firms (Betton et al., 2008). Target CAR are largely positive (22.6%) and these transactions were, on average, synergistic with an average deal CAR of 1.65%. The average four-week bid

premium is 38.89%, close to number classically reported for these kind of samples (Betton et al., 2008). The deal completion rate is 95%, which is significantly higher to what we observe in Table 1. We focus here on larger transactions (minimum deal size of USD 100 millions in place of USD 1 million) and we may suspect that such transactions are attempted only when the probability of completion is high due to the costs of undertaking them. Maybe also are SEC filings in practice harder to collect for uncompleted transactions.

1.5. Descriptive statistics

Table 5 summarizes descriptive statistics about the set of variables used to estimate the system of two simultaneous equations defined by Equations (3) and (4), and statistical test of the bidder's expected profit FOC introduced in Equation (5). As Table 5 list twenty-seven variables, we don't comment them all and limit ourselves to a few highlights for the sake of brevity.

Table 5 starts by reporting statistics on CAR, already reported in Table 4, and adds the target runup, positive (5.66%) and highly significant. Bidder CAR are significantly lower for uncompleted transactions (-2.79%), as well as target runup (difference of means of -6.96%). We then turn to probability of success and bid premium proxies. The probability of success is somewhat lower according to $\widehat{\Pr}(Success)_{Bid}$ than to $\widehat{\Pr}(Success)_{Probit}$ (respectively 71.29% and 85.90%). Both as significantly lower for uncompleted transactions (respectively -2.71 % and -14,70 % with corresponding *p*-values 0.06 and 0.00). Bid premium are close to each other (close to 40% on average). The four-week bid premium is significantly higher for uncompleted transactions, probably is sign of endogeneity. We find a higher proportion of bidders advised by so called star advisors in completed than uncompleted transactions. Apparently hiring a star advisors helps (but we may suspect here also endogeneity issues). The target to bidder relative size is 44.1%, an unusual figure (in most studies, the ratio of target to bidder lies between 10% to 5%), but this is a consequence of our sample selection criteria (minimum deal size of USD 100

million). We also observe that the relative size of targets is far higher for uncompleted transactions, an indication that larger transactions are apparently more complicated to go through. 55.68% of transaction attempts are horizontal, 24.87% are paid in cash and 38.08% in stock, 4.09% of the bidders hold a toehold and 3.38% are classified as hostile. Uncompleted transactions are more often hostile, the bidder holding a toehold in the target (a sign of hostility according to Betton et al., 2009). Because $BidderPrivateR2$, $BidderPrivateAmihud$, $BidderPrivateRoll$ are variations between the pre and the post announcement periods, numbers are themselves uninformative but we observe that, according to these three proxies of private information, the bidder level of private information decreases in the wake of the acquisition attempt announcement, as expected. We finally note that 40.94% of the transactions in our sample are initiated by the target (with a huge and significant difference between uncompleted (7.55%) and completed (42.86%) transactions) and that 48.00% of transactions are classified as negotiations (with again a huge and significant difference between uncompleted (84.91%) and completed (45.99%) transactions, an evidence consistent with Aktas et al. (2010) who report that targets going for sales by auctions are smaller).

1.6. Results

Table 6 is organized in two panels: panel A reports results obtained using the probit based proxy for the probability of success $\Pr(Success)_{Probit}$ while panel B uses the investors' proxy, $\widehat{\Pr}(Success)_{Bid}$. In each panel, the left two columns are dedicated to results using the four-week bid premium and the right two columns, the eight-week bid premium. Columns (1) report estimates of Equation (3), in which the dependent variable is the bidder CAR while columns (2) gives Equation (4), in which the dependent variable is a probability of success proxy.

The tests in Table 6 Panel A – left two columns proxy for rejects strongly the FOC of bidder's expected profit maximization with a Chi^2 statistic of 50.3 and a p-value of 0.00. The statistic point

estimate is negative, an indication of overbidding (the slope of the profit function is negative and therefore, by bidding less, the average profit would increase). The estimated coefficient of the bid premium is negative and highly significant in the bidder CAR regression and positive and highly significant in the probability of success regression[11] ~~expected~~. The bidder trade-off is clearly captured: bidding more increase the probability of doing the deal at the cost of decreasing profits in case of deal completion.

These results explicitly take into account the simultaneous nature of the relation between bidder CAR and the probability of success, a key feature of the chosen econometric approach. Some control variables also deserve comments: the deal CAR coefficient is positive and significant in the bidder CAR regression. Deal CAR being our measure of synergies, this shows that bidders are able to capture part of the created economic value. Still in the bidder CAR regression, the bidder size coefficient is positive and significant, while Boone and Mulherin (2008) report a negative and significant coefficient, but the relative size coefficient is negative and highly significant, while not being so in Boone and Mulherin (2008). Maybe some mechanic colinearity between these two variables explains this variation in results. Continuing with the bidder CAR regression, horizontal deal with a negative sign, like in Boone and Muhlerin (2008), stock payment, also with a negative sign, and toehold, with a positive sign. Concerning horizontal deal, while it is regularly reported that horizontal transactions are more synergistic (Betton et al., 2008), our specification controls explicitly for synergies with the inclusion of deal CAR. We capture thus maybe here the presence of more intense rivalry for intra-industry transactions. We note finally that hostile transactions are more value creating for bidder, maybe a sign of the disciplinary nature of these operations (but results reported in Section 2 call for caution at this level).

In the probability of success regression, we note that the bidder CAR coefficient is positive and significant, a result consistent with managers listening to investors, as argued in Luo (2005). Bidder size is

[11] The negative coefficient of the bid premium in the bidder CAR appears at first sight intuitive but, as we discuss it in Section 3, only the source of value should matter under rational bidding.

positive and significant, probably because large firms are less financially constrained. The runup variable coefficient is positive, an indication that more anticipated transactions are more likely to conclude Interestingly, the coefficient of bidder star advisor is negative and significant. This contradicts the univariate evidence reported in Table 5 and call for caution when analyzing the role of these financial institutions in the M&A market. Unsurprisingly, target industry liquidity has a positive and significant coefficient: the probability of success is higher in periods of active M&A market. Horizontal and the stock payment dummy variables are positive and significant, a result consistent with Betton et al. (2014), while the toehold dummy variable is negative and significant, a result consistent with Betton et al. (2009). Taking a toehold is apparently interpreted as a sign of aggression. We note finally that hostility decreases the probability of success, as negotiation, results consistent with the univariate evidence, but that in this multivariate setup, initiation doesn't appear to play a significant role anymore.

We obtain mostly the same results using the eight-week bid premium, as displayed in Table 6, Panel A, two right columns. We just note that, in the bidder CAR regression, bidder size loses significance while multiple bidders become significant (competition decreases bidder's profit). In the probability of success regression, target industry liquidity loses significance and multiple bidders become again significant, with a positive coefficient this time, as expected (competition increases the probability that in the end, the deal will be completed). Maybe more importantly, the bid premium coefficient is here not anymore different from zero, revealing perhaps that the eight-week bid premium is a noisier proxy for the bidder decision variable.

Table 6 Panel B reproduces Table 6 Panel A using our second proxy for the probability of success, based on investors' beliefs, $\widehat{\Pr}(Success)_{Bid}$. We observe first that, once again, the FOC of bidder's expected profit maximization is strongly rejected (Chi^2 statistic of 12.7 using the four-week bid premium and of 25.65 using the eight-week bid premium, both with a *p*-value of 0.00). We also observe the bidder trade-off is again captured: bidding more aggressively reduces bidder CAR but increase the probability of

success (like in Table 6 Panel A, the coefficient of the bid premium using the eight-week proxy is however not statistically significant the probability of success regression). The third main lesson from Table 6 Panel B is a general decrease (not to say disappearance) of statistical significance of control variable coefficients. $\widehat{\Pr}(Success)_{Bid}$ is clearly a noisier proxy for the probability of success than $\Pr(Success)_{Probit}$.

We replicate Table 6 Panels A and B estimations in Appendix 2, Panels A and B, using 2SLS. While this estimator is less efficient, potential misspecification of one equation doesn't contaminate estimations obtained for the other one. The use of 2SLS must therefore be seen as a test of robustness. Our results are almost unaffected by the change of estimator and, most importantly, the FOC of optimal bidding is again strongly rejected in all specifications.

We conclude from this first analysis that our empirical evidences bring strong support to the existence of overbidding behavior in takeover contests.

Section 2 – The bidding strategy

We follow the same developments as in Section 1. First, we introduce the intuition on which the test is built. Then, we present successively the econometric specification, the variables, the sample, descriptive statistics and, finally, our results.

2.1. Bidder's equilibrium

Takeover contests can be modeled as auctions, bidders being the set of potential acquirers (including in some cases the incumbent target management team) and sellers are either target shareholders or the target management team (depending on whether the agency relations are considered). Dasgupta and Hansen (2007) summarize a large body of literature in this area and the Roll (1986) hubris hypothesis itself builds on insights from auction theory.

The natural representation of a takeover contest is an ascending open auction (or English auction). In such an auction, the firm is put for sale, potential acquirers start bidding at a low price and progressively increase their offers. The winner is the bidder making the highest bid (as in all standard actions). English auctions have been extensively analyzed (see Krishna, 2010). Targets are fundamentally the addition of a common value good (the market value of the target is the same for all potential acquirers) and a private value good (the bidder specific synergies) . While the analysis of English auction is greatly simplified by its equivalence to second price auction in case of private goods (the value of the good is strictly bidder specific), the common value setup is more complex. Assuming symmetry of bidders, absence of budget constraint and risk neutrality, Milgrom and Weber (1982) show that the equilibrium bidding strategy $\beta(.)$ is a function of the signal received by the bidder about the value of the good and of the signals received by rival bidders having left the auction. Inferring rival signals is possible in the open ascending auction because bids at which the rival bidders leave are observable[12]. At any time during the auction, the equilibrium bidding process is driven by the bidder's value computed from these signals. The winning bidder's profit is then the difference between the winner's valuation and the second highest valuation. The Milgrom and Weber (1982) analysis makes very clear that the bidder's profit is driven by valuation and that, once valuation is taken into account, if bidders are rational, the bidding function itself has no further information content.

2.2. Econometric specification

We test the null hypothesis of bidder' rational bidding behavior by running the following equation:

$$Bidder's\ Profit = a_0 + a_1 \times Bid + a_2 \times Synergies + Control\ Variables + \varepsilon_1 \quad (9)$$

[12] Note that in case of pre-emptive bidding, the initial bidder may deter rival bidders from entering. In such a case, the initial bidder will not observe rival bids. But the mere fact that rival bidders are deterred is information about their valuations.

This specification deserves several comments:

- Under the null hypothesis of rational bidding behavior, we except α_1 to be equal to zero. In this respect, this approach parallels tests of the capital asset pricing model (CAPM), in which excess returns are regressed on betas and other variables (Fama and MacBeth, 1973). If the CAPM provides a correct description of excess return behavior, nothing should be priced except the measure of systematic risk;
- The absence of the probability of success on the right-hand side of Equation (9) raises the issue of mis-specification. We test whether our results are affected by this issue by using, in addition of the bidder CAR as a second proxy for bidder's profit, the bidder CAR rescaled by the probability of success. Testing bidder rational bidding behavior by estimating Equation (9) avoids our results to be contaminated by potential mis-specification of the probability of success model, needed to implement Section 1 test[13]. Rescaling bidder CAR by the probability of success controls for the potential missing variable issue that could affect Equation (9) estimation and can be seen as an alternative approach to the system of simultaneous equations estimation introduced in Section 1;
- Another potential issue raised by Equation (9) is the underlying symmetry assumption necessary to derive a common equilibrium bidding function among the set of potential acquirers (see Section 2.1). This is a serious issue here because Equation (9) is estimated in the cross-section. But in practice, bidders, targets and transactions are highly heterogeneous along many dimensions (bidder and target sizes, competition from other potential acquirers, relatedness of activities, etc). We add a long list of control variables to fight against this source of bias;

[13] The probability of success isn't indeed observable *per se* and must therefore, in some way or another, be estimated by a first stage model.

- Our measure of synergies (deal CAR) is potentially affected by bidder specific private information revelation concomitant with the M&A announcement, which itself is potentially correlated with bidder CAR, our dependent variable. We test the robustness of our results from this respect by using as instrument of the deal CAR, the average industry deal CAR for transactions in the bidder SIC 2-digits industry the same year as the transaction under consideration. This instrument fulfills by definition the exclusion condition (private information revelations around transaction announcements are firm specific) and we test the relevance one.

2.3. Variables[14]

Our first proxy for bidder profit is the same as in Section 1.3, the bidder CAR, computed the same way. Our second measure is the bidder CAR rescaled for the probability of success, with is the ratio of the bidder CAR to the probability of success. We use $\widehat{\Pr}\,(Success)_{Probit}$ to estimate the probability of success (see Section 1.3). Rescaled bidder CAR are a proxy for bidder's profit conditional on bid success, as explained in footnote 8. The bid premium is again either the four-week bid premium collected in the SDC database or the height-week bid premium defined at Equation (8).

Synergies are evaluated using deal CAR, computed also as in Section 1.3. We develop in complement an instrument for synergies, which is obtained by following a three steps procedure:

- We first collect all transactions announced in the bidder SIC 2-digits industry the year of the transaction under consideration (at the exclusion of the bidder's ones);
- We then compute for each transaction the deal CAR, using the Section 1.3 approach;
- We finally calculate the arithmetic average of these deals CAR.

[14] Appendix 1 provides the precise definitions and data sources of all the variables used in the empirical analysis.

The exclusion condition to obtain a valid instrument is by definition met. Because we are talking about bidder specific private information revelation, these are not cross-correlated between bidders. We provide evidence that the relevance condition is also fulfilled in the results section.

Our set of control variables include the bidder size because is a determinant of bidder profit in M&A transactions (Moeller et al., 2004), bidder free cash flow to control for agency conflicts (Jensen, 1986), bidder leverage because debt is a control mechanism of the agency relation (Jensen and Meckling, 1976), bidder market to book ratio, miss-valuation potentially explaining acquisition decisions (Shleifer and Vishny, 2003), the bidder past performance (a determinant of acquisition performance according to Rau and Vermaelen, 1998), the target size, target market to book ratio and the relative size to capture main characteristics of the good for sale, the horizontal deal, tender offer, all cash, all stock, toehold, hostile deal dummy variables, because synergies (Bradley et al., 1988), mode of payment (Travlos, 1987) and toehold (Betton et al., 2009) are known to be important characteristics of transactions. We also add a measure of bidding competition, the number of firms at least as large as the bidder in the bidder SIC 4-digits industry (large industry rivals are potential acquirer competitors during the takeover contest), a measure of M&A activity in the industry, the Schlingemann et al. (2002) M&A activity index, originally denoted the "liquidity index" by the authors.

2.4. M&A sample

The sample used to estimate Equation (9) is extracted from the SDC database using the following criteria: the period is from 1986 to 2008 (we can expand the period in this second test because there is no anymore need to collect SEC filings), both the bidder and the target are US listed firms, the deal value is at least USD 1 million, the percentage hold before transaction is below 50% and after transaction, 100%. After collecting information for all our variables (see Section 2.3), we are left with 2,730 transactions, tripling the sample size with respect to Section 1 test.

Table 7 reports descriptive statistics by year. We find the same general features as for sample presented in Tables 1 and 4: two M&A waves (end of nineties, mid of years two thousands), particularly apparent in deal value, negative bidder CAR (-1.34% on average), positive target CAR (20.68% on average), synergistic transactions (1.74% deal CAR on average) and an average four-week bid premium slightly over 40%. This comes out without surprise, the extraction criteria between the three sample being very close to each other. We just note that with respect to Section 1 sample, the mean (median) deal value is significantly lower : USD 2,839 million (USD 601 million) for Section 1 sample versus USD 1,402 million (USD 220 million) for Section 2 sample. Collecting SEC filings information clearly restricts the sample to larger transactions. Consistent with this transaction size difference, average bidder CAR are far more negative for Section 1 sample (-2.80%) than for Section 2 sample (-1.34%). The larger the transactions, the more negative the average bidder CAR (Betton et al., 2008).

2.5. Descriptive statistics

Table 8 reports the mean, median, standard deviation and the number of transactions for variables used to estimate Equation (9). In comparison with Section 1 sample (Table 5), bidder CAR are less negative (-1.34% versus -2.80%, see also Table 7), deal CAR are comparable (1.74% versus 1.66%), bid premium (four-week and eight-week) are also comparable (42.48% versus 38.7% and 42.94% versus 40.80%, respectively), bidders are, on average, slightly smaller (USD 10.2 billion versus USD 10.759 billion) and acquire significantly smaller targets (USD 0.916 billion versus USD 1.483 billion), a combination of facts that impacts the average target to bidder relative size (0.31 versus 0.44). Proportions of all cash and all stock offers are comparable (24.80% versus 24.87% and 42.38% versus 38.08%, respectively); Toehold are more frequent (6.78% versus 4.05%) and the proportion of hostile deals is also higher (4.43% versus 3.38%).

Table 8 figures also highlight that, on average, transactions in the industry are synergistic (1.89% average deal CAR in the bidder industry, which is consistent with the 1.74% average deal CAR observed in the sample). We note finally that the average bidder market to book ratio (2.10) is higher than the average target market to book ratio (1.71), an observation consistent with the Jovanovic and Rousseau (2002) Q-theory of M&As but not sufficient to validate it, as argued by Rhodes-Kropf and Robinson (2008).

2.6. Results

We report estimation results of Equation (9) in Table 9, Panels A to E. In each Panel, columns (1) and (2) display results without control variables and columns (3) and (4), with control variables. In columns (1) and (3), the bidder CAR is the dependent variable while in columns (2) and (4), it is the rescaled bidder CAR.

Starting with Table 9 Panel A, our baseline specification[15], we observe that, without control variables, the coefficient of the four-week bid premium is negative and highly significant (-0.0234 with 0.00 *p*-value and -0.0233 with 0.00 *p*-value for bidder CAR and rescaled bidder CAR, respectively). This result holds true with control variables, the magnitude of the coefficient being reinforced (-0.0234 for bidder CAR without control variables versus -0.0342 with control variables). Under rational bidding, as explained in Section 2.1, the coefficient of four-week bid premium should be equal to zero. This is strongly rejected by our results. Concerning control variables, bidder size has a positive and significant coefficient, like in Table 6, for bidder CAR regressions. Hostile has a negative and significant coefficient, in contradiction this time with results reported in Table 6. The coefficient sign inversion may be a sign of colinearity, endogeneity issue or simply due to the very limited number of hostile transactions that increase the sampling variance and calls for caution. Other control variables play a statistically significant

[15] We use here the four-week bid premium but reproduce Table 9 Panel A in Appendix 3 with the eight-week bid premium. Our results are mostly unchanged.

role: bidder leverage (positive), a confirmation of the role of leverage as a disciplinary devise (Jensen and Meckling, 1976), bidder market to book ratio (negative), a reminiscence of Rau and Vermaelen (1998) results, target size (negative), a classic results (Betton et al., 2008).

Acquisition attempt announcements reveal information not only about the acquisition but also about the bidder. Private information, by definition not observable, is therefore a latent factor correlated to both bidder CAR and deal CAR. This endogeneity issue may affect our results. We test whether it is the case using a 2SLS estimator. In the first stage, the average bidder industry deal CAR is used to build the instrument for deal CAR and in the second stage, Table 9 Panel A is estimated again, using the instrument. Table 9 Panel B reports the first stage results, with and without control variables, using deal CAR and rescaled deal CAR. The average deal CAR bidder industry coefficient is positive and strongly significant in all specifications (*p*-values of 0.00), a result that validates the relevance condition. Results in Table 9 Panel C are almost unchanged with respect to Table 9 Panel A, confirming the strong rejection of the rational bidding behavior hypothesis.

We perform a final analysis in Table 9 Panel D by replicating Equation (9) estimation on Section 1 sample. Our goal is to verify that Section 2 results are robust to a change of sample. Specifications are again the same as in Table 9 Panel A. The four-week bid premium coefficients are negative and highly significant (*p*-values of 0.00), rejecting one more time the rational bidding hypothesis. We note that, with control variables, the four-week bid premium coefficients' magnitude is doubled, pushing them even farther away from their expected value under the null hypothesis of rational bidding.

Section 3 – Overbidding complementary analyses

3.1. Overbidding determinants

The test of overbidding in Section 1 delivers a natural avenue to explore overbidding determinants. Equation (5) can be estimated on a transaction by transaction basis, using coefficients $\hat{\alpha}_1$

and $\hat{\beta}_1$ from Equations (3) and (4) respectively. Collecting bidder CAR and $\Pr(Success)_{Probit}$, our proxies for bidder profit and the probability of success (see Section 1.3), we can thereby measure of the degree of overbidding in each transaction.

The existing literature suggests several potential overbidding determinants related to agency conflicts and governance mechanisms: past performance (Rau and Vermaelen, 1998), CEO variable compensation (Grinstein and Hribar, 2004), the Gompers, Ishii and Metrick (2003) index (GIM), free cash-flow (Jensen, 1986), leverage (Jensen and Meckling, 1976), CEO age and tenure (Yim, 2012) and the CEO pay-slice (Bebchuk and al., 2011).

Starting from the Section 1 M&A sample, we are able to collect the necessary information for a sub-sample of 544 deals. Table 10 displays summary statistics. In comparison with descriptive statistics for Section 1, the M&A sample reported in Table 5, only the mean value of target industry liquidity undergoes a significant change (from 0.25 in Table 5 to 0.08 in Table 5) but its median value stays stable (around 0.06). The mean value of our measure of transaction by transaction overbidding, $DealFOC$, is negative (-0.05) and is significantly different from zero (with a p-value of 0.00, unreported).

Table 11 shows the results of our multivariate analyses. The results In Column (1), are limited to the set of variables listed above. In Column (2), we add potentially relevant variables used to estimate the system of two simultaneous equations defined by Equations (3) and (4). The inclusion of these variables also us to test the robustness of the Column (1) results to potential omitted variables. Three variables are significantly associated with an increase in overbidding: past performance (*p*-values 0.00 in Columns 1 and 2), variable compensation (*p*-value 0.04 in Column 1 and 0.03 in Columns 2) and the GIM index (*p*-value 0.09 in Column 1 and 0.03 in Column 2). These results are consistent with the existing literature: Rau and Vermaelen (1998) show that good past performers (glamour firms) underperform in the long run, Grinstein and Hribar (2004) highlight the role of M&A bonuses and Gompers et *al.* (2003). report a negative relation between entrenchment and performance. Bidder leverage decreases

overbidding (*p*-value 0.00 in Column 1 and 0.01 in Column 2), a result consistent with leverage being an external control mechanism to resolve agency conflicts (Jensen and Meckling, 1976), as does the bidder CEO's pay slice, but only marginally in Column (2) (*p*-value 0.06 in Column 1 and 0.10 in Column 2). Powerful CEOs apparently are less prone to overbid.

3.2. Overbidding and the internet bubble burst

Motivated by the observation of the late nineties internet bubble, Scheinkman and Xiong (2003) develop an equilibrium model of financial bubbles driven by overconfidence. And indeed, a salient feature of the internet bubble seems to have been overconfidence in high-technology industries. We use the burst of the bubble (the year 2001) as a significant exogenous shock to overconfidence, affecting more specifically bidders belonging to high technology industries. Under irrationality driven overbidding, we predict that the internet bubble burst should have reduced overbidding more in these industries.

We test this prediction by implementing a differences-in-differences (DD) test. The DD test is known to be particularly robust to missing factors and endogeneity issues (Roberts and Whited, 2013). Using our transaction level measure of overbidding, we estimate the two following equations:

$$DealFOC_{i,s,t} = \alpha_s + \beta_t + \gamma\ HT\_PostBubble_{i,s,t} + \epsilon_{i,s,t} \quad (10)$$

$$DealFOC_{i,s,t} = \alpha_s + \beta_t + \gamma_1\ HT\_1998_{s,t} + \cdots + \gamma_5\ HT\_2003_{s,t} + \epsilon_{i,s,t} \quad (11)$$

where $DealFOC_{i,s,t}$ is our measure of overbidding for transaction i, for deals announced in year t and in the industry s. $HT\_PostBubble$ is a dummy variable taking value one for high-technology industries (treated industries) in the post period (2001 and onwards). HT_yyyy variables are dummy variables taking value one in the *yyyy* year for high-technology industries. α_s are industry fixed-effects and β_t are year fixed effects. *p*-values are computed using standard-errors clustered at the industry level.

A critical step in implementing DD test is the identification of a treated observation (high-technology industries in our case). We follow Kile and Phillips (2009) and use the following list of 3-digits SIC codes: 283, 357, 366, 367, 382, 384, 481, 482, 489, 737 and 873. Our sample includes 978 deals, spread over 147 3-digits industries, leading to an average of 6.7 transactions per industry. Among the 978 deals, 308 took place in 9 high-technology industries.

Estimation results are reported in Table 12. The first column is dedicated to Equation (10) and the second to Equation (11). The coefficient of $HT\_PostBubble$ is positive and statistically significant (p-value 0.067): the internet bubble burst did reduce overbidding more significantly in high-technology industries, as predicted under the irrationality driven overbidding hypothesis (the less negative $DealFOC$, the less intense the overbidding). In column 2, HT_yyyy dummies decompose the internet bubble effect on high-technology industry by years. Results show that 2001 bubble burst year coefficient is the driving year, thus supporting the interpretation of column 1 results.

Section 3 results show that both agency conflicts between shareholders and CEOs and irrationality play a role in explaining bidding overbidding behavior.

Conclusion

Behavioral corporate finance has evolved markedly during the last decades. The Hubris Hypothesis suggests how irrational behavior may lead to overbidding: if bidders don't sufficiently bias bids downward to account for the winner's curse, they overvalue targets.

Only a limited number of studies report results pertaining to overbidding in M&A. Results are moreover in conflict, some authors failing to find evidence of overbidding (Moeller et al., 2004; Boone and Mulherin, 2008), others failing to reject the absence of overbidding (Berkovitch and Narayanan, 1993) or even reporting results supporting overbidding (Mueller and Sirower, 2003; Eckbo and Thorburn, 2009).

In this paper, we introduce two direct tests of overbidding in M&A transactions. The first rests on the first order condition of an acquirer's expected profit maximization. The second relies on the information content of the acquirer's equilibrium bidding function. Our results strongly support the presence of overbidding. We highlight the role of bidder past performance, bidder CEO variable compensation and entrenchment as overbidding exacerbating factors, while leverage and CEO power apparently attenuate such behavior. Using the internet bubble burst, we also report results consistent with irrationality playing a role in overbidding.

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Table 1 – Probit sample descriptive statistics

Table 1 presents the M&A sample used to estimate Equation (6). The sample includes all transactions between US bidders and US listed targets, with a deal size above USD 1 million, for which the bidder held less than 50% before the acquisition attempt and more than 50% after, reported in the SDC database between 1986 and 2008. *#Deals* is the number of deals, *Success* is the percentage of completed transaction by year, *BidPremium four-week* is the bid premium reported in the SDC database and *BidPremium eight-week* is the offer price divided by the share price of the target 42 days before the announcement date.

			BidPremium four-week		*BidPremium eight-week*	
Year	*#Deals*	*Success*	*Mean*	*Median*	*Mean*	*Median*
1986	46	26%	44.56%	44.01%	39.52%	40.35%
1987	90	20%	36.28%	31.45%	30.44%	30.32%
1988	124	19%	53.44%	51.03%	42.01%	38.94%
1989	65	15%	50.38%	47.06%	42.16%	41.18%
1990	33	24%	51.24%	41.38%	48.66%	40.97%
1991	17	24%	57.45%	53.85%	63.74%	57.14%
1992	10	30%	46.89%	39.45%	40.19%	38.67%
1993	21	38%	51.45%	49.02%	37.25%	28.16%
1994	22	41%	80.96%	63.02%	56.10%	45.53%
1995	79	49%	40.31%	36.67%	36.47%	33.29%
1996	74	58%	44.21%	39.30%	34.18%	31.60%
1997	304	85%	33.52%	30.19%	34.57%	32.20%
1998	503	84%	43.70%	33.08%	42.92%	33.33%
1999	541	82%	49.07%	41.65%	51.79%	42.76%
2000	445	80%	50.09%	44.80%	50.74%	42.86%
2001	308	87%	49.56%	40.78%	52.08%	41.91%
2002	180	81%	52.38%	37.70%	52.30%	37.18%
2003	232	85%	41.72%	31.45%	45.82%	33.79%
2004	216	88%	31.12%	26.35%	32.08%	25.58%
2005	237	85%	29.17%	25.42%	29.44%	25.00%
2006	282	83%	29.11%	24.94%	26.97%	24.16%
2007	290	81%	31.51%	26.92%	30.03%	26.82%
2008	180	69%	37.94%	29.34%	32.27%	26.58%
Total	4299	76%	42.07%	33.79%	41.37%	33.33%

Table 2 – Probit variables descriptive statistics and test of difference of means

Table 2 reports descriptive statistics for variables included in Equation (6), the probit model used to estimate the probability of acquisition attempt success (see Section 1.3), as well as a standard test of difference of means between completed and uncompleted transactions. The M&A sample is describe in Section 1.3 and Table 1. Variables are defined in Appendix 1. *Mean* is for arithmetic average, *Median* for sample median, *Stdev* for standard deviation, *t-stat* for the Student statistic of the difference of means test and *p-val*, the corresponding probability under the null hypothesis of no difference.

	All deals				*Uncompleted*	*Completed*		
Variable	*Mean*	*Median*	*Stdev*	*#Deals*	*Mean*	*Mean*	*t-stat*	*p-val*
Deal success	75.67%	100.00%	42.91%	4,299	n.a	n.a	n.a	n.a
Target Size	1,184.28	156.94	4,543.72	4,299	1,078.49	1,218.29	-0.87	0.39
NyseAmex	27.77%	0.00%	44.79%	4,299	35.85%	25.18%	6.74	0.00
Turnover	5.8053	3.6742	6.4492	4,299	5.4350	5.9243	-2.14	0.03
PoisonPill	3.40%	0.00%	18.12%	4,299	9.75%	1.35%	13.31	0.00
52WeeksHigh	-27.27%	-21.73%	22.62%	4,299	-28.70%	-26.81%	-2.35	0.02
Toehold	12.70%	0.00%	33.30%	4,299	30.50%	6.98%	20.85	0.00
ListedBidder	67.04%	100.00%	47.01%	4,299	50.86%	72.24%	-13.04	0.00
Horizontal	30.15%	0.00%	45.89%	4,299	20.84%	33.14%	-7.59	0.00
BidPremium four-week	42.07%	33.79%	41.87%	4,299	42.58%	41.91%	0.45	0.65
BidPremium eight-week	41.37%	33.33%	43.48%	4,299	37.24%	42.69%	-3.53	0.00
Tender Offer	18.54%	0.00%	38.87%	4,299	15.97%	19.37%	-2.46	0.01
AllCash	41.89%	0.00%	49.34%	4,299	50.00%	39.29%	6.13	0.00
AllStock	26.49%	0.00%	44.14%	4,299	15.97%	29.88%	-8.95	0.00
Hostile	8.58%	0.00%	28.02%	4,299	25.05%	3.29%	23.17	0.00
Year1990	37.31%	0.00%	48.37%	4,299	35.09%	38.03%	-1.71	0.09
Year2000	55.13%	100.00%	49.74%	4,299	39.96%	60.01%	-11.51	0.00

Table 3 – Probability of deal completion estimation results

Table 3 displays Equation (6) estimation results, the probit model used to estimate the probability of acquisition attempt success (see Section 1.3). The M&A sample is describe in Section 1.3 and Table 1. Variables are defined in Appendix 1. Four specifications are reported: columns (1) and (3) report results with the four-week bid premium while columns (2) and (4), with the eight-week bid premium. In columns (1) and (2), the raw bid premium are used and in columns (3) and (4), bid premium are winsorized at the one and ninety-nine percentiles. *P*-values are reported between parentheses, below coefficients.

	(1)	(2)	(3)	(4)
TargetSize	0.0551	0.0605	0.0570	0.0593
	(0.002)	(0.001)	(0.001)	(0.001)
NyseAmex	-0.270	-0.267	-0.269	-0.263
	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	-0.00992	-0.00915	-0.00964	-0.00877
	(0.012)	(0.021)	(0.014)	(0.027)
PoisonPill	-0.0902	-0.0831	-0.0884	-0.0823
	(0.598)	(0.625)	(0.605)	(0.628)
52WeeksHigh	0.467	0.565	0.488	0.567
	(0.000)	(0.000)	(0.000)	(0.000)
Toehold	-0.438	-0.424	-0.437	-0.424
	(0.000)	(0.000)	(0.000)	(0.000)
ListedBidder	0.317	0.310	0.314	0.306
	(0.000)	(0.000)	(0.000)	(0.000)
Horizontal	0.211	0.210	0.210	0.211
	(0.000)	(0.000)	(0.000)	(0.000)
BidPremium four-week	0.0166		0.0771	
	(0.203)		(0.179)	
BidPremium eight-week		0.181		0.216
		(0.000)		(0.000)
TenderOffer	1.011	1.006	1.003	1.001
	(0.000)	(0.000)	(0.000)	(0.000)
AllCash	-0.0530	-0.0456	-0.0539	-0.0491
	(0.374)	(0.446)	(0.367)	(0.411)
AllStock	0.254	0.261	0.254	0.261
	(0.000)	(0.000)	(0.000)	(0.000)
Hostile	-1.121	-1.125	-1.127	-1.124
	(0.000)	(0.000)	(0.000)	(0.000)
Year1990	0.989	0.992	0.990	0.993
	(0.000)	(0.000)	(0.000)	(0.000)
Year2000	1.201	1.207	1.202	1.209
	(0.000)	(0.000)	(0.000)	(0.000)
_cons	-0.610	-0.688	-0.637	-0.694
	(0.000)	(0.000)	(0.000)	(0.000)
N	4299	4299	4299	4299

Table 4 – Bidder's expected profit maximization test – M&A Sample

Table 4 describes the M&A sample used to estimate Equations (3) and (4) and to test Equation (5), the first-order condition of the bidder's expected profit maximization. The sample composition procedure is described in Section 1.4. We obtain a list of 977 completed and uncompleted transactions, between US listed bidders and US listed targets, with a deal size of at least USD 100 million. These are control transactions (for completed transactions, the bidder must hold less than 50% of the target shares before the transaction and more than 50% afterwards), the four-week bid premium must be available in the SDC database and SEC filings must contain necessary information to identify the deal initiator and the sales process. *#Deals* is the number of deals, *Deal Value* is reported in USD million, *Bidder CAR*, *Target CAR* and *Deal CAR* are obtained using the market model as return generating process, day minus 250 to day minus 10 with respect to the announcement date estimation window, the CRSP value weighted index as proxy for the market index and a three days event window centered around the announcement. The *BidPremium four-week* is collected in the SDC database. *Completed* the percentage of transactions reported as completed in the SDC database.

Year	*#Deals*	*Deal Value Mean*	*Deal Value Median*	*Bidder CAR Mean*	*Target CAR Mean*	*Deal CAR Mean*	*Bid Premium four-week Mean*	*Completed*
1994	2	4,969	4,969	4.18%	49.92%	18.33%	75.49%	100.00%
1995	12	845	209	0.15%	30.54%	4.24%	45.89%	67.00%
1996	16	2,767	349	-0.57%	20.23%	3.62%	29.51%	69.00%
1997	79	1,408	557	-2.31%	14.33%	1.46%	35.58%	99.00%
1998	139	4,579	790	-3.90%	20.68%	0.94%	41.69%	96.00%
1999	154	2,109	623	-3.28%	28.26%	1.14%	48.94%	94.00%
2000	99	4,249	774	-4.19%	26.44%	2.07%	51.88%	93.00%
2001	74	2,562	742	-5.21%	22.99%	-0.02%	38.12%	91.00%
2002	37	2,444	249	-1.50%	20.55%	1.28%	33.35%	95.00%
2003	74	1,613	422	-2.24%	24.59%	1.95%	37.85%	95.00%
2004	83	2,607	459	-2.79%	17.04%	1.36%	25.30%	98.00%
2005	69	4,189	715	-0.42%	20.64%	3.03%	32.20%	96.00%
2006	75	2,952	884	-1.78%	20.74%	2.02%	29.36%	97.00%
2007	64	1,403	806	-1.35%	25.55%	2.83%	31.34%	98.00%
total	977	2,839	601	-2.80%	22.60%	1.66%	38.73%	94.58%

Table 5 – Bidder's expected profit maximization test – Descriptive statistics

Table 5 reports descriptive statistics for variables used to estimate the system of two simultaneous Equations (3) and (4) and to test Equation (5), the first-order condition of the bidder's expected profit maximization. The M&A sample is describe in Section 1.4 and Table 4. Variables are defined in Appendix 1. *Mean* is the arithmetic average, *Median* the corresponding median, *Stdev*, the standard deviation of the mean. *(2)-(1)* reports the difference of means between uncompleted and completed deals and *p-val*, the corresponding statistical significance.

	All deals - 977 deals				*Completed - 924 deals*	*Uncompleted - 53 deals*		
Variable	*Mean*	*p-val*	*Median*	*Stdev*	*Mean (1)*	*Mean (2)*	*(2)-(1)*	*p-val*
BidderCAR	-2.80%	0.00	-1.94%	9.36%	-2.64%	-5.43%	-2.79%	0.03
TargetCAR	22.60%	0.00	18.55%	23.24%	22.46%	24.99%	2.53%	0.44
DealCAR	1.66%	0.00	1.12%	8.95%	1.64%	1.99%	0.35%	0.78
TargetRunup	5.66%	0.00	4.87%	20.37%	6.04%	-0.92%	-6.96%	0.02
Pr(Success)Bid	71.29%		72.41%	10.26%	71.44%	68.73%	-2.71%	0.06
Pr(Succes)Probit	85.90%		87.22%	9.52%	86.70%	72.00%	-14.70%	0.00
BidPremium four-week	38.73%		32.92%	31.19%	38.27%	46.73%	8.46%	0.05
BidPremium eight-week	40.83%		33.89%	36.62%	40.76%	42.00%	1.24%	0.81
BidderSize	10,759.21		2,418.51	30,725.89	11,032.82	5,989.17	5043.65	0.25
BidderStarAdv	37.97%		0.00%	48.56%	39.29%	15.09%	-24.19%	0.00
TargetSize	1,483.60		356.52	4,511.14	1,491.29	1,349.62	-141.6650	0.82
TargetIndLiquidity	0.2504		0.0633	5.2138	0.2590	0.0995	-0.1595	0.83
RelativeSize	0.4437		0.1872	0.8793	0.4197	0.8616	0.4419	0.00
Horizontal	0.5568		1	0.4970	0.5649	0.4151	-0.1498	0.03
AllCash	24.87%		0.00%	43.25%	24.57%	30.19%	5.62%	0.36
AllStock	38.08%		0.00%	48.58%	38.85%	24.53%	-14.32%	0.04
Toehold	4.09%		0.00%	19.83%	3.03%	22.64%	19.61%	0.00
Hostile	3.38%		0.00%	18.07%	2.16%	24.53%	22.36%	0.00
BidderPrivateR2	0.0197	0.00	-0.0026	0.1923	0.0195	0.0235	0.0040	0.88
BidderPrivateAmihud	-0.2808	0.00	-0.3072	0.3000	-0.2875	-0.1644	0.1230	0.00
BidderPrivateRoll	-0.5583	0.01	-0.8549	6.8037	-0.4534	-2.3876	-1.9343	0.04
Initiation	40.94%		0.00%	49.20%	42.86%	7.55%	-35.31%	0.00
Negotiation	48.00%		0.00%	49.99%	45.89%	84.91%	39.02%	0.00
MultipleBidder	4.40%		0.00%	20.52%	4.65%	0.00%	-4.65%	0.11

Table 6 – Bidder's expected profit maximization test – 3SLS Results

Table 6 summarizes estimation results of the system of two simultaneous equations defined at Equations (3) and (4) and the ensuing test of the bidder's expected profit maximization FOC (Equation 5). Estimations are obtained using the 3SLS estimator. Standard-errors are robust to heteroskedasticity and p-values are reported between parentheses. The M&A sample is describe in Section 1.4 and Table 4. Variables are defined in Appendix 1. *Coeff* stands for coefficient and *p-val* for p-value. *Chi2* is the chi-squared statistic of the cross-equation restriction defined at Equation 5 and *FOC test*, the corresponding point estimate. Panel A uses the probit based proxy for the probability of success $\Pr(Success)_{Probit}$ and Panel B, the investors' anticipations bid premium based ($\widehat{\Pr}(Success)_{Bid}$). The two proxies are defined in Section 1.3. The left Columns (1) and (2) report results using the *BidPremium four-week* and the right ones, using *BidPremium eight-week*. Columns (1) are dedicated to Equation (3) estimation (bidder CAR dependent variable) and Columns (2), to Equation (4) estimation (probability of success dependent variable).

Panel A - $\widehat{\Pr}(Success)_{Probit}$

	BidPremium four-week				BidPremium eight-week			
	(1)		(2)		(1)		(2)	
	BidderCAR		*Pr(Success)probit*		*BidderCAR*		*Pr(Success)probit*	
	Coeff	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*
BidderCAR			0.0694	(0.022)			0.0790	(0.017)
DealCAR	0.8450	(0.000)			0.8300	(0.000)		
TargetRunup			0.0694	(0.000)			0.0846	
Pr(Succes)Probit	0.6660	(0.000)			0.9510	(0.000)		
Bid Premium	-0.0625	(0.000)	0.0636	(0.004)	-0.0602	(0.000)	0.0058	(0.432)
BidderSize	0.0047	(0.004)	0.0047	(0.001)	0.0032	(0.122)	0.0046	(0.002)
BidderStarAdv			-0.0074	(0.032)			-0.0061	(0.038)
TargetIndLiquidity			0.0006	(0.090)			0.0003	(0.362)
RelativeSize	-0.0156	(0.000)	0.0023	(0.409)	-0.0160	(0.000)	0.0017	(0.541)
Horizontal	-0.0169	(0.006)	0.0241	(0.000)	-0.0239	(0.003)	0.0241	(0.000)
AllStock	-0.0160	(0.010)	0.0243	(0.000)	-0.0211	(0.009)	0.0231	(0.000)
Toehold	0.0594	(0.004)	-0.1040	(0.000)	0.0863	(0.003)	-0.1050	(0.000)
Hostile	0.1580	(0.000)	-0.2620	(0.000)	0.2260	(0.000)	-0.2580	(0.000)
BidderPrivateR2	0.0114	(0.378)	-0.0245	(0.040)	0.0160	(0.316)	-0.0234	(0.049)
BidderPrivateAmihud	0.0112	(0.166)	-0.0056	(0.473)	0.0137	(0.164)	-0.0049	(0.529)
BidderPrivateRoll	-0.0003	(0.414)	0.0002	(0.534)	-0.0003	(0.429)	0.0002	(0.520)
Initiation			-0.0009	(0.814)			-0.0008	(0.820)
Negotiation			-0.0135	(0.001)			-0.0095	(0.017)
MultipleBidder	-0.0104	(0.383)	0.0161	(0.158)	-0.0273	(0.067)	0.0202	(0.074)
_cons	-0.6090	(0.000)	0.8090	(0.000)	-0.8380	(0.000)	0.8130	(0.000)
N	977		977		977		977	
FOC Test	-0.0543				-0.0518			
Chi2	50.3	(0.0000)			28.59	(0.0000)		

Panel B - $\widehat{\Pr}\,(Succes)_{Bid}$

	BidPremium four-week				BidPremium eight-week			
	(1)		(2)		(1)		(2)	
	BidderCAR		*Pr(Success)bid*		*BidderCAR*		*Pr(Success)bid*	
	Coeff	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*
BidderCAR			0.0849	(0.048)			0.1090	(0.017)
DealCAR	0.8390	(0.000)			0.8730	(0.000)		
TargetRunup			0.0546	(0.000)			-0.0259	(0.249)
Pr(Succes)Bid	0.5860	(0.200)			-0.0015	(0.993)		
Bid Premium	-0.0658	(0.000)	0.0350	(0.001)	-0.0277	(0.000)	0.0011	(0.926)
BidderSize	0.0043	(0.149)	0.0054	(0.010)	0.0075	(0.000)	0.0014	(0.532)
BidderStarAdv			-0.0020	(0.734)			-0.0074	(0.318)
TargetIndLiquidity			-0.0002	(0.583)			-0.0001	(0.873)
RelativeSize	-0.0182	(0.000)	0.0066	(0.093)	-0.0153	(0.000)	-0.0032	(0.454)
Horizontal	0.0079	(0.337)	-0.0152	(0.021)	0.0003	(0.932)	-0.0023	(0.744)
AllStock	0.0071	(0.378)	-0.0130	(0.064)	0.0006	(0.883)	-0.0071	(0.349)
Toehold	-0.0201	(0.173)	0.0156	(0.360)	-0.0160	(0.088)	-0.0008	(0.962)
Hostile	0.0012	(0.953)	-0.0245	(0.193)	-0.0217	(0.054)	0.0327	(0.112)
BidderPrivateR2	-0.0049	(0.722)	-0.0012	(0.942)	-0.0103	(0.310)	0.0266	(0.147)
BidderPrivateAmihud	0.0088	(0.346)	-0.0026	(0.811)	0.0059	(0.382)	0.0171	(0.157)
BidderPrivateRoll	-0.0004	(0.300)	0.0005	(0.279)	-0.0001	(0.565)	-0.0006	(0.206)
Initiation			0.0058	(0.233)			0.0034	(0.677)
Negotiation			-0.0066	(0.169)			-0.0161	(0.677)
MultipleBidder	0.0037	(0.772)	-0.0050	(0.757)	-0.0035	(0.685)	-0.0095	(0.585)
_cons	-0.4650	(0.126)	0.6680	(0.000)	-0.0806	(0.301)	0.4460	(0.000)
N	977		977		974		974	
FOC Test	-0.0479				-0.0198			
Chi2	12.7	(0.000)			25.65	(0.000)		

Table 7 – Bidder's bidding strategy – M&A Sample

Table 7 presents the M&A sample used to estimate Equation (9). The sample includes transactions between US listed bidders and US listed targets, with a deal size above USD 1 million, for which the bidder held less than 50% before the acquisition and 100% afterwards, reported in the SDC database between 1994 and 2007. *#Deals* is the number of deals, *Deal Value* is the amount paid for the acquisition in USD million, as reported in the SDC database. *BidderCAR*, *TargetCAR*, *DealCAR* are respectively the bidder, the target and the deal CAR (variables are defined in Appendix 1). *BidPremium four-week* is the bid premium reported in the SDC database. *Completed* the percentage of transactions reported as completed in the SDC database.

Year	*#Deals*	*Deal Value Mean*	*Deal Value Median*	*Bidder CAR Mean*	*Target CAR Mean*	*Deal CAR Mean*	*BidPremium four-week Mean*	*Completed*
1986	65	429	157	1.18%	20.12%	5.20%	40.64%	72.00%
1987	73	437	157	-0.90%	20.27%	2.94%	41.92%	63.00%
1988	82	292	107	0.23%	20.05%	3.25%	60.89%	60.00%
1989	63	912	135	-0.38%	17.74%	3.31%	47.09%	59.00%
1990	24	553	68	0.17%	22.06%	3.68%	51.02%	83.00%
1991	39	386	131	-2.00%	21.87%	0.88%	56.45%	74.00%
1992	35	345	164	-2.09%	16.22%	0.15%	53.97%	80.00%
1993	43	1,092	193	-1.41%	17.47%	1.31%	52.17%	74.00%
1994	97	435	106	-0.37%	16.60%	2.10%	37.91%	77.00%
1995	174	689	142	-0.81%	19.60%	1.97%	37.92%	83.00%
1996	187	1,039	196	0.46%	17.53%	3.24%	36.40%	83.00%
1997	285	967	275	-0.20%	14.90%	2.37%	37.13%	86.00%
1998	259	1,553	231	-1.95%	18.45%	1.61%	46.06%	87.00%
1999	271	1,847	338	-0.63%	22.62%	1.97%	50.72%	84.00%
2000	193	3,269	310	-4.01%	22.07%	0.48%	48.27%	84.00%
2001	173	1,136	154	-1.88%	27.03%	0.88%	45.69%	87.00%
2002	74	1,342	146	-4.32%	29.57%	-1.22%	44.39%	82.00%
2003	100	780	150	-1.59%	23.48%	0.93%	41.87%	94.00%
2004	117	2,486	284	-2.12%	19.34%	0.90%	32.60%	93.00%
2005	93	3,068	405	-2.34%	18.16%	0.66%	32.75%	91.00%
2006	96	2,081	509	-0.86%	18.01%	1.43%	29.61%	93.00%
2007	113	1,348	587	-1.34%	26.26%	2.20%	32.95%	88.00%
2008	74	1,800	206	-4.81%	35.62%	-0.70%	44.41%	77.00%
total	2730	1,402	220	-1.34%	20.68%	1.74%	42.48%	83.04%

Table 8 – Bidder's bidding strategy test – Descriptive statistics

Table 8 reports descriptive statistics for variables used to estimate Equation (9). The M&A sample is describe in Section 2.4 and Table 7. Variables are defined in Appendix 1. *Mean* is the arithmetic average, *Median* the corresponding median, *Stdev*, the standard deviation of the mean and *#Deals*, the number of deals

Variables	*Mean*	*Median*	*Stdev*	*#Deals*
BidderCAR	-1.34%	-1.05%	9.02%	2730
DealCAR	1.74%	1.39%	8.36%	2730
BidderIndCAR	1.89%	1.36%	4.49%	2730
BidPremium four-week	42.48%	35.28%	40.98%	2730
BidPremium eight-week	42.94%	34.75%	43.69%	1908
Pr(Sucess)Probit	97.94%	99.44%	5.57%	2730
BidderSize	10,241.06	1,271.77	34,283.67	2730
BidderFreeCashFlow	0.0180	0.0291	0.1280	2730
BidderLeverage	0.1632	0.1102	0.1663	2730
BidderMarketToBook	2.1025	1.4194	1.8512	2730
BidderPastPerformance	0.06%	0.04%	0.18%	2730
Horizontal	35.46%	0.00%	47.85%	2730
TargetSize	916.92	138.67	3,669.32	2730
TargetMarketToBook	1.7138	1.2252	1.2942	2730
RelativeSize	0.3169	0.1410	0.7102	2730
TenderOffer	16.23%	0.00%	36.88%	2730
AllCash	24.80%	0.00%	43.19%	2730
AllStock	42.38%	0.00%	49.43%	2730
Toehold	6.78%	0.00%	25.14%	2730
Hostile	4.43%	0.00%	20.58%	2730
Number of large firms in industry	15.58	3	36.64	2730
M&AActivityIndex	0.0527	0.0321	0.0669	2730

Table 9 – Bidder's bidding strategy test

Table 9 summarizes estimation results of Equation (9). Standard-errors are robust to heteroskedasticity and p-value are reported between parentheses. The M&A sample is described in Section 2.4 and Table 7. Variables are defined in Appendix 1. *Coeff* stands for coefficient and *p-val* for p-value. *Adj-R-sq* is the adjusted R square coefficient. Panel A reports results obtained using the four-week bid premium and the standard OLS estimator. Panels B and C are dedicated to estimation results using the 2SLS to instrument the *DealCAR* variable. In Panel B, we present the first stage estimation results (regression of *DealCAR* on Average *DealCAR* Bidder Industry) and in Panel C, the second stage results (regression of *BidderCAR* on the instrument). Panel D displays results obtained using dollar CAR and the OLS estimator. And, finally, in Panel E, we show results obtained by estimating Equation (9) using the Section 1 sample.

Panel A – OLS Results – Bid Premium four-week

	(1)		(2)		(3)		(4)	
	BidderCAR		BidderCAR Rescaled		BidderCAR		BidderCAR Rescaled	
	Coeff	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*
DealCAR	0.8800	(0.000)			0.9160	(0.000)		
DealCAR Rescaled			0.8690	(0.000)			0.9120	(0.000)
BidPremium four-week	-0.0234	(0.000)	-0.0233	(0.000)	-0.0342	(0.000)	-0.0345	(0.000)
BidderSize					0.0133	(0.000)	0.0137	(0.000)
BidderFreeCashFlow					-0.0061	(0.702)	-0.0072	(0.653)
BidderLeverage					0.0165	(0.049)	0.0160	(0.063)
BidderMarketToBook					-0.0013	(0.072)	-0.0014	(0.069)
BidderPastPerformance					-0.2050	(0.863)	-0.1910	(0.874)
TargetSize					-0.0161	(0.000)	-0.0164	(0.000)
TargetMarketToBook					0.0007	(0.464)	0.0006	(0.488)
RelativeSize					0.0115	(0.273)	0.0112	(0.292)
TenderOffer					-0.0037	(0.230)	-0.0022	(0.498)
AllCash					0.0029	(0.232)	0.0022	(0.386)
AllStock					0.0046	(0.044)	0.0050	(0.033)
Toehold					-0.0022	(0.645)	-0.0070	(0.198)
Hostile					-0.0160	(0.003)	-0.0282	(0.000)
Horizontal					-0.0010	(0.615)	-0.0008	(0.711)
Number of large firms in industry					-0.0011	(0.131)	-0.0011	(0.168)
M&AActivityIndex					-0.0107	(0.476)	-0.0088	(0.571)
_cons	-0.0187	(0.000)	-0.0196	(0.000)	-0.0122	(0.167)	-0.0144	(0.122)
N	2,730		2,730		2,730		2,730	
adj. R-sq	65.50%		65.60%		71.40%		71.70%	

Panel B – 2SLS Results – Bid Premium four-week – First Stage Regression

	(1)		(2)		(3)		(4)	
	DealCAR		DealCAR Rescaled		DealCAR		DealCAR Rescaled	
	Coeff	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*
BidderIndCAR	0.1880	(0.000)	0.2080	(0.000)	0.1170	(0.001)	0.1280	(0.000)
BidPremium four-week	0.0233	(0.000)	0.0241	(0.000)	0.0270	(0.000)	0.0280	(0.000)
BidderSize					-0.0115	(0.000)	-0.0121	(0.000)
BidderFreeCashFlow					0.0001	(0.997)	-0.0005	(0.978)
BidderLeverage					0.0287	(0.011)	0.0329	(0.006)
BidderMarketToBook					-0.0004	(0.809)	-0.0001	(0.960)
BidderPastPerformance					-2.6940	(0.050)	-2.8970	(0.039)
TargetSize					0.0063	(0.000)	0.0066	(0.000)
TargetMarketToBook					-0.0004	(0.836)	-0.0005	(0.807)
RelativeSize					0.0034	(0.358)	0.0046	(0.307)
TenderOffer					0.0173	(0.000)	0.0167	(0.001)
AllCash					0.0170	(0.000)	0.0192	(0.000)
AllStock					-0.0053	(0.136)	-0.0050	(0.190)
Toehold					0.0020	(0.739)	0.0060	(0.436)
Hostile					0.0142	(0.072)	0.0242	(0.041)
Horizontal					-0.0037	(0.235)	-0.0038	(0.231)
Number of large firms in industry					-0.0058	(0.000)	-0.0061	(0.000)
M&AActivityIndex					-0.0109	(0.659)	-0.0140	(0.583)
_cons	0.0039	(0.131)	0.0042	(0.126)	0.0923	(0.000)	0.0954	(0.000)
N	2,730		2,730		2,730		2,730	
adj. R-sq	2.20%		2.30%		9.90%		10.70%	

Panel C – 2SLS Results – Bid Premium four-week – Second Stage Regression

	(1)		(2)		(3)		(4)	
	BidderCAR		BidderCAR Rescaled		BidderCAR		BidderCAR Rescaled	
	Coeff	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*
DealCAR	0.8820	(0.000)			1.0200	(0.000)		
DealCAR Rescaled			0.8580	(0.000)			1.0230	(0.000)
BidPremium four-week	-0.0234	(0.000)	-0.0231	(0.000)	-0.0370	(0.000)	-0.0376	(0.000)
BidderSize					0.0146	(0.000)	0.0151	(0.000)
BidderFreeCashFlow					-0.0064	(0.685)	-0.0075	(0.638)
BidderLeverage					0.0133	(0.219)	0.0121	(0.291)
BidderMarketToBook					-0.0013	(0.076)	-0.0014	(0.062)
BidderPastPerformance					0.0871	(0.947)	0.1450	(0.912)
TargetSize					-0.0168	(0.000)	-0.0171	(0.000)
TargetMarketToBook					0.0007	(0.448)	0.0007	(0.466)
RelativeSize					0.0111	(0.276)	0.0107	(0.305)
TenderOffer					-0.0055	(0.224)	-0.0041	(0.356)
AllCash					0.0011	(0.798)	0.0001	(0.990)
AllStock					0.0051	(0.036)	0.0056	(0.025)
Toehold					-0.0026	(0.592)	-0.0079	(0.164)
Hostile					-0.0175	(0.007)	-0.0308	(0.000)
Horizontal					-0.0006	(0.777)	-0.0003	(0.885)
Number of large firms in industry					-0.0005	(0.703)	-0.0003	(0.799)
M&AActivityIndex					-0.0098	(0.521)	-0.0076	(0.636)
_cons	-0.0188	(0.000)	-0.0195	(0.000)	-0.0224	(0.268)	-0.0257	(0.206)
N	2,730		2,730		2,730		2,730	
adj. R-sq	65.50%		65.60%		70.60%		70.80%	

Panel D – OLS Results – Bid Premium four-week – Section 1 Sample

	(1)		(2)		(3)		(4)	
	BidderCAR		BidderCAR Rescaled		BidderCAR		BidderCAR Rescaled	
	Coeff	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*
DealCAR	0.8250	(0.000)			0.9230	(0.000)		
DealCAR Rescaled			0.8050	(0.000)			0.9270	(0.000)
BidPremium four-week	-0.0333	(0.000)	-0.0400	(0.000)	-0.0634	(0.000)	-0.0766	(0.000)
BidderSize					0.0203	(0.000)	0.0242	(0.000)
BidderFreeCashFlow					0.0147	(0.650)	0.0161	(0.691)
BidderLeverage					0.0180	(0.143)	0.0151	(0.314)
BidderMarketToBook					-0.0015	(0.193)	-0.0024	(0.090)
BidderPastPerformance					0.4210	(0.758)	0.9090	(0.592)
TargetSize					-0.0230	(0.000)	-0.0266	(0.000)
TargetMarketToBook					0.0002	(0.866)	0.0006	(0.692)
RelativeSize					-0.0003	(0.969)	-0.0016	(0.871)
TenderOffer					-0.0061	(0.388)	0.0030	(0.738)
AllCash					0.0081	(0.086)	0.0105	(0.078)
AllStock					0.0092	(0.024)	0.0146	(0.008)
Toehold					-0.0167	(0.376)	-0.0364	(0.218)
Hostile					0.0024	(0.838)	-0.0475	(0.022)
Horizontal					0.0033	(0.304)	0.0081	(0.047)
Number of large firms in industry					-0.0014	(0.298)	-0.0016	(0.335)
M&AActivityIndex					0.0000	(0.603)	0.0003	(0.020)
_cons	-0.0287	(0.000)	-0.0342	(0.000)	-0.0434	(0.000)	-0.0582	(0.000)
N	979		979		959		959	
adj. R-sq	61.20%		58.90%		72.30%		71.10%	

Table 10 – Overbidding determinants – Descriptive statistics

Table 10 reports descriptive statistics for variables used to study determinants of overbidding. The M&A sample is a sub-sample of sample describe in Section 1.4 and Table 4, composed of 544 transactions for which we have been able to collect the necessary information. Variables are defined in Appendix 1. *Mean* is the arithmetic average, *Median* the corresponding median, *Stdev*, the standard deviation of the mean and *#Deals*, the number of deals

Variables	*Mean*	*Median*	*Stdev*	*#Deals*
DealFOC	-0.0546	-0.0555	0.0063	544
BidderSize	14,663.76	4,380.57	38,296.47	544
BidderStarAdv	0.4210	0.0000	0.4942	544
TargetIndLiquidity	0.0806	0.0637	0.0820	544
RelativeSize	0.3363	0.1226	0.6731	544
Horizontal	0.5533	1.0000	0.4976	544
Toehold	0.0276	0.0000	0.1639	544
Hostile	0.0423	0.0000	0.2014	544
Initiation	0.4099	0.0000	0.4923	544
Negotiation	0.4632	0.0000	0.4991	544
MultipleBidder	0.0588	0.0000	0.2785	544
BidderPastPerformance	0.0005	0.0005	0.0013	544
BidderVariableCompensation	0.8105	0.8479	0.1650	544
BidderGIMIndex	9.4577	9.0000	2.6458	544
BidderFreeCashFlow	0.0530	0.0461	0.0638	544
BidderLeverage	0.1560	0.1299	0.1324	544
BidderCEOAge	55.7721	56.0000	6.4325	544
BidderCEOTenure	7.8566	5.0000	7.4338	544
BidderCEOPaySlice	0.4004	0.4016	0.1235	544

Table 11 – Overbidding determinants – Multivariate analyses

Table 11 summarizes multivariate analyses of overbidding determinants. The dependent variable, $DealFOC$, is the degree of overbidding, obtained by estimating Equation (5). Column (1) reports results when limiting ourselves to independent variables of interest and column (2), results obtained when adding relevant control variables used to estimate the system of two simultaneous equations defined at Equations (3) and (4). Standard-errors are robust to heteroskedasticity and p-value are reported between parentheses. The M&A sample is described in Table 10. Variables are defined in Appendix 1. *Coeff* stands for coefficient and *p-val* for p-value. *Adj-R-sq* is the adjusted R square coefficient.

	(1)		(2)	
	DealFOC		*DealFOC*	
	Coeff	*p-val*	*Coeff*	*p-val*
BidderPastPerformance	-0.7950	(0.000)	-0.6480	(0.000)
BidderVariableCompensation	-0.0048	(0.044)	-0.0041	(0.032)
BidderGIM index	-0.0002	(0.094)	-0.0002	(0.035)
BidderFreeCashFlow	0.0006	(0.879)	-0.0026	(0.451)
BidderLeverage	0.0056	(0.003)	0.0038	(0.011)
BidderCEOAge	0.0042	(0.056)	-0.0006	(0.767)
BidderCEOTenure	0.0000	(0.981)	0.0000	(0.852)
BidderCEOPaySlice	0.0050	(0.055)	0.0033	(0.101)
BidderSize			0.0001	(0.693)
BidderStarAdv			0.0005	(0.285)
TargetIndLiquidity			-0.0008	(0.820)
RelativeSize			-0.0003	(0.501)
Horizontal			-0.0018	(0.000)
Toehold			0.0065	(0.003)
Hostile			0.0165	(0.000)
Initiation			0.0013	(0.002)
Negotiation			0.0006	(0.186)
MultipleBidder			-0.0002	(0.865)
_cons	-0.0681	(0.000)	-0.0501	(0.000)
N	544		544	
adj. R-sq	0.058		0.392	

Table 12 – Overbidding and the Internet Bubble Burst

Table 12 displays the results of differences-in-differences tests of overbidding behavior in high-technology industries around the internet bubble burst (see Section 3.2). We follow Kile and Phillips (2009) for high-technology industry identification. Column (1) reports estimation of Equation (10). *HT_PostBubble* is a dummy variable taking value one for high-technology industries (treated industries) in the post period (2001 and onwards). Column (2) reports estimation of Equation (11). *HT_yyyy* variables are dummy variables taking value one in the *yyyy* year for high-technology industries. Both specification includes industry and year dummies. *Coeff*, *p-val*, *N* and *adj. R-sq* stand respectively for coefficient, *p*-value, number of observations and adjusted R square coefficient. *p*-values are clustered at the industry level.

	(1)		(2)	
	DealFOC		*DealFOC*	
	Coeff	*p-val*	*Coeff*	*p-val*
HT_PostBubble	0.0013	(0.067)		
HT_1998			0.0013	(0.186)
HT_1999			-0.0021	(0.138)
HT_2000			-0.0009	(0.513)
HT_2001			0.0033	(0.040)
HT_2002			0.0001	(0.954)
HT_2003			-0.0030	(0.015)
Sector FE	yes		yes	
Years FE	yes		yes	
N	978		978	
adj. R-sq	24.93%		25.93%	

Appendix 1 – Variable definitions

Variable	Definition	source
52WeeksHigh	target stock price on day minus 42 before the annoucement over the maximum target stock price observed during the 52 weeks before day minus 42	crsp
AllCash	Dummy variable =1 if the consideration is cash only and 0 otherwise	sdc
AllStock	Dummy variable =1 if the consideration is stock only and 0 otherwise	sdc
BidderGIMIndex	Bidder Gompers et al. (2003) governance index	riskmetric
BidderCAR	Bidder CAR over the three days event windows centered on the annoucement date, estimated with a market model and with an estimation windows day minus 250 to day minus 10. CRSP value weighted index is used as proxy of the market index	crsp,sdc
BidderCARRescaled	BidderCAR divided by Pr(Succes)Probit	
BidderCEOAge	Bidder CEO's age in year. Logarithm is used in the regression	execucomp
BidderCEOPaySlice	Percentage of the bidder CEO's total pay (item TDC1) among the top five executives as in Bebchuck et al. (2011)	execucomp
BidderCEOTenure	Bidder CEO's tenure: difference between the year of the deal and the year in which the CEO is appointed. Logarithm is used in the regression	execucomp
BidderFreeCashFlow	Income before extraordinary items (compustat item IBC) divided by total assets (compustat item AT)	compustat
BidderIndCAR	average DealCar in the sector (same SIC 2 digits) of the bidder during the year of the deal annoucement	crsp,sdc
BidderLeverage	Long term debt (compustat item DLTT) divided by total assets (compustat item AT)	compustat
BidderMarketToBook	Total assets minus common equity (compustat item CEQ) plus the market value of equity (compustat items CSHO*PRCC_F) divided by total assets (compustat item AT)	compustat
BidderPastPerformance	Abnormal return (alpha) obtained form the estimation of the market model estimated during the period day minus 250 to day minus 20	crsp,sdc
BidderPrivateAmihud	relative variation of the bidder Amihud(2002) illiquidity ratio between the pre (day minus 61 to day minus 42) and the post annoucement period (day plus 42 to day plus 61)	crsp,sdc
BidderPrivateR2	relative variation of the value of $1-R^2$, obtained from the estimation of the market model, between the pre (day minus 61 to day minus 42) and the post annoucement period (day plus 42 to day plus 61)	crsp,sdc
BidderPrivateRoll	relative variation of the covariance between bidder lagged return between the pre (day minus 61 to day minus 42) and the post announcement period (day plus 42 to day plus 61)	crsp,sdc
BidderSize	market value of bidder in USD million 42 days before announcement (logarihm is used in the regression)	crsp,sdc
BidderStarAdv	Dummy variable = 1 if the bidder is advised by one of the top-6 financial advisors, representing more than 70% of the total transaction values of M&A deals advised by the top-25 financial advisors during the entire period (1994-2007) and 0 otherwise.	sdc
BidderVariableCompensation	Variable component of the bidder CEO's compensation : (item TDC1-item SALARY)/item TDC1	execucomp
BidPremium4Weeks	offer price divided by market price of the target 4 weeks before the announcement (computed by sdc)	sdc
BidPremium8Weeks	offer price divided by market price of the target 42 days before the announcement (computed by authors)	crsp,sdc
DealSuccess	Dummy variable =1 if deal is successed and 0 otherwise	sdc

DealCAR	weighted average of BidderCAR and TargetCAR by market value computed in day minus 42	crsp,sdc
DealCARRescaled	DealCAR divided by Pr(Succes)Probit	
DealFOC	First order condition estimated value for one deal (Equation (5)). Computation is based on the estimation of the system of Equations (3) and (4)	crsp, compustat, sdc
Horizontal	dummy variable = 1 if Bidder and target have the same sic code 4 digit, 0 otherwise	sdc
Hostile	dummy variable = 1 if the deal is classified hostile by sdc, 0 otherwise	sdc
HT_PostBubble	dummy variable = 1 if the bidder is in sector HT (Kile et philipps (2009) definition) and the deal announced during the period post internet bubble (after 2000)	sdc
HT_YYYY	dummy variable = 1 if the bidder is in sector HT (Kile et philipps (2009) definition) and the deal announced during the years yyyy	sdc
Initiation	dummy variable= 1 if the target initiated the deal, 0 otherwise.	SEC fillings
ListedBidder	Dummy variable =1 if the bidder is a public firm, 0 otherwise	sdc
M&AActivityIndex	Schlingeman (2002) liquidity index. Ratio of the value of M&A transactions in a year to the total asset (item compustat AT) of firms in the bidder two-digit SIC code for that year.	Sdc, compustat
MultipleBidder	Dummy variable=1 if the number of bidders reported in the SDC is greater than one, 0 otherwise	sdc
Negotiation	Dummy variable = 1 if the selling procedure is a negotiation (if SEC filings indicates one buyer), 0 otherwise	SEC fillings
Number of large firms in industry	the number of firms at least as large as the bidder in the bidder SIC 4-digits industry	compustat, sdc
NyseAmex	Dummy variable =1 if the bidder is quoted in Nyse or Amex stockexchange, 0 otherwise	sdc
PoisonPill	Dummy variable = 1 if target has a poison pill (from sdc), 0 otherwise	sdc
Pr(Succes)Probit	Fitted probability of success estimated from a probit model (Equation (6))	crsp,compustat,sdc
Pr(Success)Bid	Target CAR divided by *Bid Premium 4 weeks* or *Bid Premium 8 weeks* both computed during the same period (4 weeks or 8 weeks before the annoucement date) ,rescaled between 0 and 1.	crsp,sdc
RelativeSize	ratio of target market value computed on day minus 42 on bidder market value computed in day minus 42	sdc
TargetCAR	target CAR over the three days event windows centered on the annoucement date, estimated with a market model and with an estimation windows day minus 250 to day minus 10	crsp,sdc
TargetIndLiquidity	Schlingeman (2002) liquidity index. Ratio of the value of M&A transactions in a year to the total asset (item compustat AT) of firms in the target two-digit SIC code for that year.	sdc,compustat
TargetIndCAR	average DealCar in the sector (same SIC 2 digits) of the target during the year of the deal annoucement	crps,sdc
TargetMarketToBook	Total assets minus common equity (item compustat CEQ) plus the market value of equity (item compustat CSHO*PRCC_F) divided by total assets (item compustat AT)	compustat
TargetRunup	target stock performance during the period between day minus 42 and day minus 6	crsp,sdc
TargetSize	target market value in USD million 42 days before announcement (logarithm is used in regression)	crsp,sdc
TenderOffer	Dummy variable = 1 if the deal is classified as a tender offer by sdc, 0 otherwise	sdc
Toehold	Dummy variable = 1 if the bidder holds a non-zero percentage target's share before the annoucement, 0 otherwise	sdc

Turnover	target average daily ratio of trading volume to total shares outstanding over the 52 weeks before the announcement	crsp
Year1990	dummy variable =1 if the deal is announced in the period 1990 to 1999 (dummy), 0 otherwise	sdc
Year2000	dummy varaible = 1 if the deal is announced in the period 2000 to 2009 (dummy), 0 otherwise	sdc

Appendix 2 – Bidder's expected profit maximization test – 2SLS Results

Appendix 2 reproduces results displayed in Table 6 Panels A and B, using the 2SLS estimator in place of the the 3SLS.

Panel A - $\widehat{\mathbf{Pr}}(\boldsymbol{Success})_{\boldsymbol{Probit}}$

	BidPremium four-week				BidPremium eight-week			
	(1)		(2)		(1)		(2)	
	BidderCAR		*Pr(Success)probit*		*BidderCAR*		*Pr(Success)probit*	
	Coeff	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*
BidderCAR			0.0659	(0.031)			0.0615	(0.042)
DealCAR	0.8450	(0.000)			0.8300	(0.000)		
TargetRunup			0.0502	(0.000)			0.0292	(0.049)
Pr(Succes)Probit	0.6660	(0.000)			0.9510	(0.000)		
Bid Premium	-0.0625	(0.000)	0.0217	(0.005)	-0.0602	(0.000)	0.0239	(0.004)
BidderSize	0.0047	(0.004)	0.0043	(0.005)	0.0032	(0.125)	0.0044	(0.003)
BidderStarAdv			-0.0047	(0.335)			-0.0051	(0.303)
TargetIndLiquidity			0.0013	(0.003)			0.0014	(0.002)
RelativeSize	-0.0156	(0.000)	0.0016	(0.574)	-0.0160	(0.000)	0.0018	(0.532)
Horizontal	-0.0169	(0.006)	0.0247	(0.000)	-0.0239	(0.004)	0.0247	(0.000)
AllStock	-0.0160	(0.011)	0.0250	(0.000)	-0.0211	(0.009)	0.0250	(0.000)
Toehold	0.0594	(0.005)	-0.1040	(0.000)	0.0863	(0.003)	-0.1020	(0.000)
Hostile	0.1580	(0.000)	-0.2690	(0.000)	0.2260	(0.000)	-0.2670	(0.000)
BidderPrivateR2	0.0114	(0.382)	-0.0247	(0.040)	0.0160	(0.320)	-0.0241	(0.046)
BidderPrivateAmihud	0.0112	(0.170)	-0.0068	(0.393)	0.0137	(0.167)	-0.0077	(0.330)
BidderPrivateRoll	-0.0003	(0.417)	0.0002	(0.565)	-0.0003	(0.432)	0.0002	(0.598)
Initiation			-0.0085	(0.114)			-0.0082	(0.129)
Negotiation			-0.0150	(0.005)			-0.0158	(0.003)
MultipleBidder	-0.0104	(0.386)	0.0167	(0.149)	-0.0273	(0.070)	0.0203	(0.078)
_cons	-0.6090	(0.000)	0.8150	(0.000)	-0.8380	(0.000)	0.8130	(0.000)
N	977		977		977		977	
FOC Test	-0.0542				-0.0523			
F	51.4	(0.0000)			29.56	(0.0000)		

Panel B - $\widehat{\mathbf{Pr}}\,(\boldsymbol{Succes})_{\boldsymbol{Offer}}$

	BidPremium four-week				BidPremium eight-week			
	(1)		(2)		(1)		(2)	
	BidderCAR		*Pr(Success)bid*		*BidderCAR*		*Pr(Success)bid**	
	Coeff	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*
BidderCAR			0.0736	(0.048)			0.1070	(0.021)
DealCAR	0.8390	(0.000)			0.8730	(0.000)		
TargetRunup			0.0103	(0.000)			-0.0344	(0.130)
Pr(Succes)Bid	0.5860	(0.203)			-0.0015	(0.993)		
BidPremium	-0.0658	(0.000)	0.0392	(0.001)	-0.0277	(0.000)	0.0041	(0.750)
BidderSize	0.0043	(0.152)	0.0042	(0.010)	0.0075	(0.000)	0.0014	(0.550)
BidderStarAdv			0.0104	(0.734)			-0.0069	(0.356)
TargetIndLiquidity			-0.0001	(0.583)			-0.0001	(0.902)
RelativeSize	-0.0182	(0.000)	0.0049	(0.093)	-0.0153	(0.000)	-0.0033	(0.456)
Horizontal	0.0079	(0.341)	-0.0143	(0.021)	0.0003	(0.932)	-0.0022	(0.757)
AllStock	0.0071	(0.381)	-0.0132	(0.064)	0.0006	(0.884)	-0.0071	(0.357)
Toehold	-0.0201	(0.176)	0.0141	(0.360)	-0.0160	(0.090)	-0.0009	(0.962)
Hostile	0.0012	(0.953)	-0.0283	(0.193)	-0.0217	(0.056)	0.0321	(0.122)
BidderPrivateR2	-0.0049	(0.724)	-0.0033	(0.942)	-0.0103	(0.314)	0.0263	(0.155)
BidderPrivateAmihud	0.0088	(0.349)	-0.0049	(0.811)	0.0059	(0.386)	0.0167	(0.171)
BidderPrivateRoll	-0.0004	(0.304)	0.0005	(0.279)	-0.0001	(0.568)	-0.0007	(0.208)
Initiation			0.0021	(0.233)			0.0031	(0.707)
Negotiation			0.0018	(0.169)			-0.0157	(0.056)
MultipleBidder	0.0037	(0.773)	-0.0027	(0.757)	-0.0035	(0.687)	-0.0092	(0.602)
_cons	-0.4650	(0.129)	0.6700	(0.000)	-0.0806	(0.304)	0.4450	(0.000)
N	977		977		974		974	
FOC Test	-0.0480				-0.0199			
F	12.79	(0.000)			25.62	(0.000)		

Appendix 3 – Bidder's bidding strategy test – eight-week bid premium

	(1)		(2)		(3)		(4)	
	BidderCAR		BidderCAR Rescaled		BidderCAR		BidderCAR Rescaled	
	Coeff	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*
DealCAR	0.8800	(0.000)			0.9160	(0.000)		
DealCAR Rescaled			0.8680	(0.000)			0.9110	(0.000)
BidPremium eight-week	-0.0168	(0.000)	-0.0161	(0.000)	-0.0310	(0.000)	-0.0312	(0.000)
BidderSize					0.0145	(0.000)	0.0149	(0.000)
BidderFreeCashFlow					-0.0107	(0.551)	-0.0118	(0.515)
AcquierLeverage					0.0136	(0.205)	0.0130	(0.237)
BidderMarketToBook					-0.0017	(0.041)	-0.0018	(0.040)
BidderPastPerformance					-0.4080	(0.768)	-0.4290	(0.759)
TargetSize					-0.0171	(0.000)	-0.0174	(0.000)
TargetMarketToBook					0.0001	(0.928)	0.0001	(0.932)
RelativeSize					0.0137	(0.264)	0.0136	(0.270)
TenderOffer					-0.0062	(0.101)	-0.0049	(0.215)
AllCash					0.0046	(0.102)	0.0044	(0.144)
AllStock					0.0042	(0.152)	0.0046	(0.133)
Toehold					-0.0063	(0.373)	-0.0127	(0.105)
Hostile					-0.0160	(0.006)	-0.0273	(0.000)
Horizontal					-0.0012	(0.629)	-0.0009	(0.735)
Number of large firms in industry					-0.0014	(0.155)	-0.0014	(0.162)
TargetIndLiquidity					-0.0028	(0.889)	-0.0006	(0.977)
_cons	-0.0239	(0.000)	-0.0240	(0.000)	-0.0193	(0.089)	-0.0206	(0.080)
N	1,908		1,908		1,908		1,908	
adj. R-sq	64.30%		64.50%		70.90%		71.50%	