Internet Appendix for "Strategic and Financial Bidders in Takeover Auctions"

ALEXANDER S. GORBENKO and ANDREY MALENKO*

*Gorbenko is with London Business School. Malenko is with MIT Sloan School of Management.

The Internet Appendix contains a further discussion of validity of the empirical approach, a discussion of challenges of using data on takeovers completed in securities, and additional empirical results omitted from the paper.

Further Discussion of Approach Validity

Sample selection. One issue that can create a problem in interpretation of the results is sample selection bias. Specifically, our sample consists of: *(i)* takeovers in which the winning bid was made in cash, and *(ii)* takeovers that were completed. Because bids in stock are almost exclusively submitted by strategic bidders rather than by financial bidders, considering only takeover auctions in which the winning bid was made in cash creates a bias that increases (decreases) estimates of valuations for financial (strategic) bidders. Elimination of this bias will increase the difference between average valuations of strategic and financial bidders. As for particular coefficients in the sample that contains auctions won in both cash and stock, the size coefficient will likely be smaller in absolute value for strategic bidders, because the ability to bid in stock relaxes their financial constraints and allows them to compete for larger targets. Further, because the ability to bid in stock is likely to be independent from debt market conditions, in the full sample of completed takeovers financial bidders will lose an even larger proportion of deals when the credit spread is high, so the coefficient on the credit spread for their valuation will likely decrease.

Because our sample consists of takeovers that were completed, the estimates of valuations are likely to be biased upwards compared to the ex-ante valuations of targets that are unconditional on the sale having been completed. Intuitively, takeover auctions, in which bidders' valuations are lower, are less likely to result in a sufficiently high premium for the target, and as a result, are typically not observed by the researcher. Because of this sample selection issue, our valuations must be interpreted as valuations conditional on the sale of the target rather than unconditional valuations. However, it is unclear why this bias would have systematically different effects on strategic and financial bidders that lead to a significant differences between them other than those we estimate.

Common values. Another potential issue is the assumption that the unobserved component of valuations is independent across bidders in the auction for the same target. Clearly, in reality valuations of different bidders can have a common component that is not reflected in the observable characteristics of the target. In other words, while we attribute $\varepsilon_{i,j}$ to the private component of the bidder's valuation, in reality part of it can be attributed to the common component. In our discussion of this concern, we distinguish between two different cases: 1) the common component is observable to the bidders (but not to the researcher) during due diligence, and 2) the common component is only partially observable to the bidders during due diligence.

If the common component is observable to the bidders prior to submitting bids, then the problem of common values is equivalent to that of unobserved heterogeneity. It can affect the interpretation of the difference between σ_s and σ_f as the difference in the levels of heterogeneity of strategic and financial bidders. However, note that the estimated difference between σ_s and σ_f is very high: in the base model, we estimate σ_s to be 68.6% higher than σ_f. To have such a large difference between σ_s and σ_f and the same level of heterogeneity of strategic and financial bidders at the same time, it must be the case that a very large part of the unobserved component is attributed to the common component for strategic bidders and a very small part of the unobserved component is attributed to the common component for financial bidders. This is unlikely to be the case in the takeover market. In fact, it is often asserted that common component of valuations is more important for financial bidders than for strategic bidders (e.g., Bulow, Huang, and Klemperer, 1999).

If the common component is only partially observable to each bidder prior to submitting bids through an imperfect signal, then bidders will rationally shade their bids by inferring signals of other bidders from the bidding process. As a result, valuations estimated from data on bids are likely to be lower and less dispersed than valuations of bidders after due diligence but before the auction starts. The difference increases with the amount by which bidders shade their bids, which increases in turn with the amount of information revealed in the bidding process. In general, testing for the presence of common values from the data on bidding is important but very difficult (or even impossible) without observing detailed data on how bidders adjust their bids as information arrives.

Model of synergies. Another important assumption is the functional form of bidders' valuations. Specifically, we assume that the maximum amount that the bidder is willing to pay for the target is proportional to the value of the target's equity under the current management. While proportionality to some benchmark value is an intuitive assumption, given that the set of characteristics includes the size of the target and its q-ratio, the choice of benchmark could be different. A reasonable alternative assumption is that the maximum willingness to pay is proportional to the enterprise value of the target rather than the value of equity. While this approach is plausible from a theoretical perspective, it is problematic to apply empirically because the dynamics of the target's enterprise value are not perfectly observed. More precisely, while the market value of equity is observed on a daily basis from the data on stock prices, the enterprise value of the target is observed only quarterly when the data on cash balances and debt are reported. Likely because of this problem, the imperfect measure of the enterprise value, which is constructed as the current market value of equity less cash balances plus the book value of debt, where the latter two components are taken from the latest financial statement data is negative or close to zero for approximately 6% of the targets in the sample. Because of these data imperfections, our estimation approach is based on the assumption that the valuations are proportional to the market value of the target's equity. Nevertheless, as a robustness check, we also used data on targets, whose ratio of the winning bid to enterprise value is truncated by one from below and four from above, to estimate a model based on enterprise values, and we found very similar results.

Measurement of the value under the current management. In the estimation of the baseline model, we measure the value of the target under its current management as its market value four weeks before the takeover announcement if there was no press-release announcing the sale process before, and one day before the announcement of the sale process otherwise. For robustness, we also reestimated the model using a different measure of the value of the target under its current management: the market value three months before the takeover announcement if there was no public announcement of the sale process, and one day before the announcement of the sale process otherwise. The results of the estimation are similar to those reported in Table V in the paper.

The Challenges of Modeling Takeovers Completed in Securities

Our sample only contains takeover auctions completed in cash. Below we present the problems that one has to overcome to study valuations in takeovers completed in securities:

1. *The cash value of a stock bid to the bidder is unknown to the researcher*

   When a bidder's value of a bid is unknown, the consequence is a potentially large bias in recovering boundaries of valuations for all bidders, especially if such a bidder wins. If the bidder makes a bid of $X in cash, it is clear that her valuation of the target must be at least $X. However, if the bidder makes a stock bid evaluated at $X (market value) using the current stock price, then it is unclear whether her actual valuation of the target is bounded from below by $X. For example, if the bidder believes that her stock is overpriced, then her actual valuation of the bid can be below $X.

   Suppose first that a stock bidder wins an auction. Then a bias in the lower boundary of the winner's valuation is introduced. Critically, this bias immediately affects the upper boundaries of all the losing bidders who should have had their valuations bounded from above by the actual value of the winning bid to the winner. As a result, valuation intervals of all auction participants are biased.

   Next, suppose that a cash bidder wins an auction. Then there is no bias in the lower boundary on the winner's valuation and as a result in the upper boundaries of the valuations of the other bidders. While losing stock bidders can still have a bias in the lower boundaries of their valuations, such bias is quantitatively negligible, because the number of losing stock bids in these auctions is small. For these bidders, we employ a conservative estimate for their valuations: we assume that their valuations are above the target's value under the current management. However, because the number of losing stock bids is small in our sample, the results are not sensitive to this assumption.

2. *The cash value of a stock bid to the target is unknown to the researcher (and can be different from the value both to the market and to the bidder).*

   This problem is related to the first one but is even more challenging: it makes the ordering of stock bids ambiguous. For example, if bidder A offers a stock bid evaluated at $X at current stock price, and bidder B offers a stock bid evaluated at $Y>$X at current stock price, the target may still accept a bid of bidder A because of the private belief that there is less adverse selection in the stock of bidder A. Without imposing controversial assumptions, it will be difficult to reliably recover valuations for this subsample of auctions for takeovers completed in stock.

Though beyond the scope of this paper, modeling and estimation of auctions with noncash bids using available data represents an interesting and challenging direction of future research.

Additional Results

Finally, we report several additional results omitted from the paper.

First, it is reasonable to assume that the valuation of a strategic bidder is a function of its joint leverage with target. Because we observe the identity of a bidder in few cases,[1] estimating such model is challenging. We adopt the following approach. Assume that the valuation of a strategic bidder is given by

$$\log v_{i,j} = X_i'\beta_s + \gamma_1 JL_{i,j} + \gamma_2 JL_{i,j}^2 + u_{i,j}, \tag{IA.1}$$

where $JL_{i,j}$ is the joint leverage of a strategic bidder j and target i. The valuation model of financial bidders is unchanged. If we observe the identity of a strategic bidder, we can calculate the joint leverage of the strategic bidder with the target:

$$JL_{i,j} = \frac{L_i \times Size_i + L_j \times Size_j}{Size_i + Size_j}, \tag{IA.2}$$

where $Size_i$ is the quasi-market size of company i (the sum of the market value of its equity and the book value of its debt). If we do not observe the identity of a strategic bidder or if a strategic bidder is a private firm, we do not know its joint leverage with the target. We assume that the pool of strategic bidders with unknown identities is similar to the pool of public corporations operating in the same industry as the target. Specifically, for every target i we look at all N_i companies with data in COMPUSTAT operating in the same 2-digit SIC industry code in the same quarter. Given these data, we calculate the first two moments of

[1] The identity of the winning bidder is always known, but the identity of a losing bidder is only known if its bid is public, which is rare.

$JL_{i,j}$ and $JL_{i,j}^2$ and their covariance. Then, the equation that we estimate is:

$$\text{(IA.3)} \qquad \log v_{i,j} = \begin{cases} X_i'\beta_s + \gamma_1 JL_{i,j} + \gamma_2 JL_{i,j}^2 + u_{i,j}, & \text{if } JL_{i,j} \text{ is observed,} \\ X_i'\beta_s + \gamma_1 \mathbb{E}\left[JL_{i,j}\right] + \gamma_2 \mathbb{E}\left[JL_{i,j}^2\right] + \hat{u}_{i,j}, & \text{if } JL_{i,j} \text{is unobserved,} \end{cases}$$

where $Var\left[u_{i,j}\right] = \sigma_s^2$, and:

$$\text{(IA.4)} \qquad Var\left[\hat{u}_{i,j}\right] = \sigma_s^2 + \gamma_1^2 Var\left[JL_{i,j}\right] + \gamma_2^2 Var\left[JL_{i,j}^2\right] + 2\gamma_1\gamma_2 Cov\left(JL_{i,j}, JL_{i,j}^2\right).$$

That is, technically, we use $\mathbb{E}[\log(v_{ij})|JL_{ij}]]$ whenever the identity of a bidder is not observable, similarly to what we do when the type of a bidder is not observable.[2] Assuming independence and normality of $u_{i,j}$ and $\hat{u}_{i,j}$, we estimate (IA.3) - (IA.4) using Maximum Likelihood, like we did for the main model.

The results are reported in Table IA.I. First, it is the joint leverage that is associated with valuations of strategic bidders, not the leverage of the target. Indeed, the individual leverage of the target loses its significance after accounting for the joint leverage. The rest of the original coefficients are virtually unaffected. Second, as expected, the magnitude of the effect of leverage for strategic bidders goes up in comparison with the main model.

Second, we estimated an extension of the model, in which the variance of the unobserved component of valuations can differ for different targets. The idea behind this extended model is that the importance of the unobserved component of bidders' valuations varies from target to target. For example, if synergies of strategic bidders are more important for target A than

[2]The resulting likelihood in case of unobserved identity then becomes the expected likelihood under the assumption that a bidder is from the same 2-digit SIC industry as the target.

for target B, we expect that valuations of different strategic bidders of target A are more dispersed. This is because synergies are bidder-target-specific. We modify the model of the variance of unobservable valuation component in the following way:

$$\sigma_{t_{i,j}} = Y_i' \delta_{t_{i,j}},$$

where δ_s and δ_f are sensitivities of the standard deviation to target characteristics, and Y includes a constant term (so that our original model is embedded in this extended model). Then, we jointly estimate the set of coefficients $(\beta_s, \beta_f, \delta_s, \delta_f)$. The results are presented in Table IA.II. Overall, the estimation results conform to our expectations. First, we expect the "fit" of a target to a particular strategic bidder to be more important if the target is smaller and has greater investment opportunities. Consistent with this, we find a negative significant coefficient in the variance equation for the size of the target and a positive significant coefficient for R&D expenditures of the target. Intuitively, it is reasonable to expect that synergies are more important if the target does more R&D and if it is smaller. Interestingly, we do not find that these characteristics are important for the unobserved component of financial bidders, suggesting that size and R&D capture something that is unique to strategic bidders and not to financial bidders. We also find significantly positive coefficients for leverage of the target and credit spread in the economy. These coefficients are significant for both strategic and financial bidders. Thus, the unobserved component of valuations appears most important when bidders bid for highly-levered targets and at times of expensive debt.

Finally, to further explore the role of financial bidders, we construct a counterfactual in which we simulate auction outcomes in the absence of financial bidders in different states of the economy. First, we split our full sample into two subsamples based on whether S&P500 in the preceding 12 months is negative (downturns) or positive (upturns). Second, we split our full sample into two subsamples based on whether the credit spread is above 275*bp* ("expensive" debt) or below ("cheap" debt). In both splits, the subsample with the "bad" state of the economy comprises approximately 25% of the full sample. For each of the four subsamples, we compare simulated average lower and upper bounds on the takeover premium in the presence and in the absence of financial bidders. The results are reported in Table IA.III.

If financial bidders are absent in takeover auctions after the period of negative market returns, both the upper and lower bounds on the takeover premium fall by approximately 7-8% of the value of the target under its current management. When we do a similar analysis for takeover auctions after the period of positive market returns, we find that the upper and lower bounds on the takeover premium fall by approximately 6-7%. This is a sizable effect: Because the average takeover premium is about 40%, the absence of financial bidders will reduce the takeover premium by approximately 15-20%. The effect is marginally higher in downturns and considerably higher for targets which perform poorly and have low investment opportunities, i.e., targets valued more by financial bidders than by strategic bidders. The results are similar if credit spread is used to define good and bad times. These results should be interpreted with two caveats in mind. First, our model does not account for endogenous entry. In reality, if financial bidders are not allowed to participate, more strategic bidders are likely to enter the auction. This dampens the negative effect of non-participation by financial bidders. Second, in bad times, fewer targets will be approached/put for sale if financial bidders are not present.

References

Bulow, Jeremy, Ming Huang, and Paul Klemperer, 1999, Toeholds and Takeovers, *Journal of Political Economy,* 107, 427–454.

Table IA.I.
Model with Joint Leverage of Strategic Bidders with the Target

The table shows the estimation results of the modified baseline model (Model II), in which a strategic bidder's valuation can depend on its joint leverage with the target. Bold font denotes 5% significance. Statistical significance is indicated by ***,**, and * for the 0.01, 0.05, and 0.10 levels. The sample covers 01/01/2000 to 09/06/2008.

	Strategic	Financial	Diff.
St. Dev. of PV	0.227***	0.152***	0.075***
	(0.008)	(0.003)	(0.009)
Joint Leverage	1.337***	–	–
	(0.225)	–	–
Joint Leverage^2	-2.895***	–	–
	(0.346)	–	–
Const	0.120*	0.149***	-0.029
	(0.070)	(0.023)	(0.074)
log(Size)	-0.031***	-0.000	-0.030***
	(0.007)	(0.003)	(0.008)
Leverage	0.049	0.192***	-0.142
	(0.192)	(0.062)	(0.205)
Leverage^2	0.232	-0.196***	0.428
	(0.290)	(0.075)	(0.302)
q-ratio	-0.000	0.002	-0.002
	(0.009)	(0.008)	(0.013)
Cash Flow	-0.027	-0.383***	0.355***
	(0.027)	(0.052)	(0.059)
Cash	0.155***	0.053	0.102
	(0.050)	(0.035)	(0.064)
R&D	1.441***	-0.040	1.481**
	(0.315)	(0.478)	(0.588)
Intangibles	0.030	-0.091***	0.121**
	(0.053)	(0.025)	(0.060)
SP500 Growth	-0.098	-0.258***	0.160
	(0.110)	(0.045)	(0.121)
Credit Spread	1.856	-2.483	4.339*
	(1.997)	(1.682)	(2.396)

Table IA.II.
Model with Target-Specific Unobserved Components of Valuations

The table shows the estimation results of the modified baseline model (Model II), in which the standard deviation of the unobserved component of valuations can depend on characteristics of the target and the economy (*Size*, *Leverage*, *R&D*, *Credit Spread*). The first five rows correspond to estimates of δ_s and δ_f of the standard deviations of unobserved components. The other rows correspond to estimates β_s and β_f of the model of average valuations. Statistical significance is indicated by ***,**, and * for the 0.01, 0.05, and 0.10 levels. The sample covers 01/01/2000 to 09/06/2008.

	Strategic	Financial	Diff.
St. Dev. (Const)	0.257***	0.078***	0.179***
	(0.046)	(0.023)	(0.053)
St. Dev. (log(Size))	-0.024***	-0.003	-0.021***
	(0.005)	(0.002)	(0.006)
St. Dev. (Leverage)	0.110**	0.151***	-0.041
	(0.047)	(0.015)	(0.051)
St. Dev. (R&D)	0.829**	-0.308	1.137**
	(0.414)	(0.274)	(0.513)
St. Dev. (Credit Spread)	3.992***	2.586***	1.406
	(1.328)	(0.770)	(1.609)
Const	0.086	0.164***	-0.078
	(0.085)	(0.035)	(0.094)
log(Size)	-0.011	-0.000	-0.011
	(0.009)	(0.004)	(0.010)
Leverage	0.573***	0.240***	0.333*
	(0.172)	(0.067)	(0.190)
Leverage^2	-0.689***	-0.433***	-0.257
	(0.241)	(0.098)	(0.268)
q-ratio	0.012	0.014**	-0.002
	(0.010)	(0.006)	(0.013)
Cash Flow	-0.100**	-0.488***	0.388***
	(0.040)	(0.050)	(0.065)
Cash	0.143***	0.027	0.117*
	(0.054)	(0.031)	(0.065)
R&D	1.606***	0.376	1.230
	(0.532)	(0.595)	(0.839)
Intangibles	-0.052	-0.127***	0.074
	(0.046)	(0.024)	(0.054)
SP500 Growth	-0.064	-0.173***	0.109
	(0.117)	(0.046)	(0.129)
Credit Spread	-0.338	-2.672***	2.334
	(2.498)	(0.761)	(2.663)

Table IA.III.
Counterfactual Analysis: Impact of Non-participation by Financial Bidders in Different States of the Economy

The table shows the results of a counterfactual analysis in a simulated economy, in which bidders value targets according to Model II, Table V of the paper. Each target in the sample is replicated 100 times; for each replication, a different set of bidder valuations is simulated. Two situations are compared: *(i)* All bidders participate; *(ii)* financial bidders are not allowed to participate. The average difference between *(ii)* and *(i)* in the bounds on the takeover premium is recorded for two different splits of the full sample: First, for booms (S&P 500 ≥ 0) versus recessions (S&P 500 < 0); second, for low ($\leq 275bp$) versus high ($> 275bp$) credit spread.

	Δ lower bound	Δ upper bound
Upturns	-0.069	-0.061
Downturns	-0.078	-0.071
Low Credit Spread	-0.069	-0.061
High Credit Spread	-0.077	-0.067