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Information Uncertainty and Target Valuation in Mergers and Acquisitions

by

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Abstract: We examine how a target's information uncertainty level affects an acquirer's valuation of the target and the acquirer's gain realized from the transaction. Based on a simple perpetual discounted cash flow model, we argue that the valuation will be lower for a target with higher information uncertainty and acquiring a target with high information uncertainty can potentially create value for an acquirer's shareholders. The empirical findings lend support to our arguments. Specifically, we observe that a target's valuation multiple obtained from an acquirer is negatively correlated with the target's information uncertainty level. An acquirer's announcement return is negatively correlated with the valuation multiple given to the target but positively correlated with the target's information uncertainty level. The results are robust against various measurements of valuation multiples and information uncertainty.

Keywords: information uncertainty, bid premium, valuation multiple, acquirer abnormal return

JEL Codes: G14, G32, G34

1. Introduction

Whether a takeover market creates value for shareholders, especially shareholders of the acquiring firm, is still unclear. Traditional evidence typically shows that acquirers earn at most non-positive returns upon bid announcement.[1] Moeller et al. (2004) even notice some massive scale-of-wealth destruction in some big mergers in the late 1990s. Nonetheless, Fich et al. (2016) argue that there is similar cyclicality in the time-series distribution of both large gain and large loss mergers and acquisitions deals and show that large gain deals are just as concentrated in the bull market of the late 1990s as large loss deals are. Alexandridis et al. (2017) document that acquiring firms realize substantial gains in mega-deals announced after year 2009. They interpret that as due to profound improvements in the quality of corporate governance among acquiring firms in the aftermath of the 2008 financial crisis. International evidence also finds that acquiring public firms earn significant positive returns when outside US, UK, and Canada region (e.g., Alexandridis et al., 2010).

These studies generally explore the value creation function of takeover from the perspectives of acquirer and deal characteristics.[2] Much less is known about the impact of target characteristics on takeover transactions. In this study, we try to explore this issue by examining the association of target characteristics and acquirer's gain realized in takeover transactions. Specifically, we focus on how a target's level of information uncertainty affects its valuation obtained from an acquirer in a takeover transaction and how such valuation associated with

[1] See Jensen and Ruback (1983) and Andrade et al. (2001) for a review of takeover literature.

[2] These include market valuation (Shleifer and Vishny, 2003), managerial overconfidence/hubris (Hayward and Hambrick, 1997; Roll, 1986), diversifying strategy (Morck et al., 1990), payment method (Loughran and Vijh, 1997; Rau and Vermaelen, 1998), acquisition form (Berkovitch and Khanna, 1991; Bhagat et al., 2005), acquisition attitude (Cotter and Zenner, 1994), accounting recording method (Robinson and Shane, 1990), etc. See Section 3.4 for a detailed discussion of these factors.

information uncertainty affects the acquirer's returns from the acquisition.

We propose that a target's information uncertainty could be an important source of value creation for an acquirer's shareholders. The intuition is that the value of target shares would be heavily discounted by the market when the target suffers serious information uncertainty problems. The acquirer, however, has an information advantage over the market about the target due to additional information acquired through the process of due diligence.[3] As a result, the target share is more valuable to the acquirer than to the market, the difference of which will be the source of the potential gain to the acquirer.

The target's information uncertainty also works to the advantage of the acquirer through the merger negotiation process. A merger is a bargaining process between the acquirer and the target (Berkovitch and Khanna, 1991; Subramanian, 2005). To the extent that serious information uncertainty problems put the target in a weak position to bargain with the acquirer, the latter would hence be able to complete the deal at a bargain value and/or negotiate for a bigger portion of the potential synergetic gain from the merger.

Our proposition carries several testable implications. First, a target's valuation obtained from an acquirer would be negatively correlated with the target's level of information uncertainty. Second, a target's bid premium would be positively related with the target's level of information uncertainty. Third, an acquirer's announcement return would be negatively correlated with the valuation given to the target but positively correlated with the target's level of information uncertainty.

We test the predictions with a sample of 2,676 acquisitions announced during the period 1986–2015. We find that targets with high information uncertainty receive a low valuation

[3] In Povel and Singh's (2006) model, a target suffering from serious information uncertainty may invite the bidder to conduct investigation about the target or disclose information to potential bidders.

multiple from the acquirers. This result holds in a series of robustness tests with different measures of information uncertainty and valuation multiples. Evidently, when it is difficult to evaluate a target with high information uncertainty, an acquirer tends to be more conservative in their bidding. This is particularly true for non-overconfident acquirer CEOs. We find that non-overconfident CEOs in acquiring firms give an even lower valuation to opaque targets than their overconfident peers.

We also find that a target with high information uncertainty receives a high bid premium in the takeover transaction, consistent with earlier studies (e.g., Cheng et al., 2016; Raman et al., 2013). We examine the association between valuation multiple and bid premium but find no constant relationship.

Acquirer announcement return falls if an acquirer gives a high valuation multiple to a target. On the other hand, the acquirer announcement return increases with the target's level of information uncertainty. These results show that an acquirer benefits from the acquisition of an opaque target, and the low valuation multiple given to the opaque target could be a significant factor in making the deal profitable for the acquirer.

Our study establishes a direct link of acquirers' announcement returns with valuation bargains based on the targets' information uncertainty. The literature on takeovers finds that, while acquiring firms experience zero or negative announcement returns in the acquisitions of US listed firms, they earn significant positive returns when acquiring public firms outside US, UK, and Canada region (e.g., Alexandridis et al., 2010). Acquiring firms also experience significantly positive abnormal returns when acquiring unlisted firms or subsidiaries of other firms (e.g., Chang, 1998; Fuller et al., 2002; Hansen and Lott, 1996; Moeller et al., 2004).[4]

[4] Faccio et al. (2006) find that such a pattern persists after controlling for any hypotheses proffered in the literature, such as the creation of a blockholder in the bidder, the method of payment, the relative size

Although studies report the existence of acquisition discounts for unlisted targets (Koeplin et al., 2000; Officer, 2007), a specific association between such acquisition discounts and positive announcement returns for acquirers has never been formally established, and no reason behind such an association has ever been proposed.

In this study, we establish such a link in a general setting (i.e., not limited to unlisted targets) by arguing that the underlying reason is the target's information uncertainty. Targets with information uncertainty suffer valuation discounts by the market, which opens a window of opportunity for acquirers to grab and enjoy positive acquisition returns.[5] The logic is conceptually the same as the value created by stock analysts through searching for information on the stocks they follow. In the takeover context, an acquirer acts like a stock analyst, searching for the true value of a target firm not realized by market investors due to information uncertainty. Moreover, our argument needs not assume mispricing for targets. In our view, the acquirer buys the opaque target whose shares are correctly priced, though discounted. The acquirer profits through paying a "cheap" target that is actually worth more. Using Bradley et al.'s (1983) terminology, the target is "sitting on the goldmine," which is unnoticed and unpriced. The acquirer reaps the "goldmine" alongside the acquisition without paying for it.

Our study therefore provides a simple but useful implication to corporate acquirers and acquisition advisors. For companies thinking of acquisitions, advisors could propose to them those public firms—if not private ones—with serious information uncertainty. They are

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of the target, pre-announcement leakage of information about the transaction, and so on.

[5] As for private firms, they generally have more information uncertainty than public firms have. As such, private firms would get a lower valuation from acquirers, and the acquirers would accordingly get a higher return from the acquisitions. Officer (2007) views that the sources of the discounts of unlisted targets come from the liquidity needs of these targets, although he acknowledges that information uncertainty is the likely explanation for the portion of acquisition discounts that cannot relate to aggregate or firm-specific liquidity factors (p. 597). Cooney et al. (2009) have an interesting finding that positive acquirer announcement returns are mainly driven by targets being subsequently acquired for more than their prior valuations.

potentially good acquisition targets, as their value is typically discounted heavily by the market. As long as the acquirers have the ability to see through the true values of these targets, significant value will be created through acquisitions.

Our study also clarifies the link between the valuation multiple, a measure commonly adopted by practitioners to value takeover targets, and the bid premium, a measure widely used by researchers to measure acquirers' pricing of takeover targets. Extant research on the valuation process in takeover transactions has investigated the bid premium received by a target, but only a few examine target valuation from the perspective of valuation multiples.[6] Specifically, studies find that a target's information uncertainty level has a positive impact on the bid premium received from an acquirer (e.g., Chatterjee et al., 2012; Raman et al., 2013), whereas the literature typically reports a negative impact of information uncertainty on asset pricing.[7]

In this study, we build a simple model to show that an opaque target can simultaneously receive a low valuation multiple and a high bid premium. Our empirical results also provide supporting evidence.[8] The results based on valuation multiple are helpful to reconciling the pieces of evidence about the association of information quality and asset valuation documented under various contexts.

[6] Koeplin et al. (2000) and Officer (2007) investigate the pricing discounts of private companies relative to public firms in takeover transactions from the perspective of valuation multiples.

[7] Beatty and Ritter (1986) and Rock (1986) find that information uncertainty plays a significant role on the expected asset underpricing in a firm's IPO process. In the placement of private assets, Hertzel and Smith (1993) find that information uncertainty can substantially explain the market discounts for private assets. Information uncertainty also has a significant negative effect on the cost of raising equity capital (e.g., Botosan, 1997; Botosan and Plumlee, 2002; Botosan et al., 2004; Francis et al., 2004).

[8] The practical cases of mergers and acquisitions also provide support for our analysis. For instance, Gilead obtained its Hepatitis C franchise in 2011 through the acquisition of the clinical-stage biotech company Pharmasset, with an offer of $11 billion. Some investors believed that Gilead had overpaid, as the offer price was an 89% premium to Pharmasset's stock price. However, in an article in *The Wall Street Journal*, financial columnist Grant (2015) asserted that the deal was actually very inexpensive for Gilead because the deal price accounts for just 69% of trailing 12-month hepatitis C sales, considering that bid prices for deal targets in the same industry were elevated later. For instance, AbbVie paid 3.8 times the Wall Street consensus for peak sales in its Pharmacyclics acquisition in 2015.

However, although we show that acquirers pay high bid premiums for opaque targets, the explanation is different from prior studies. Chatterjee et al. (2012) argue that the demand curve for the target's shares becomes steeper when there is more divergence of opinion about the target's value. In this case, the successful takeover bid price needs to be higher as well. Raman et al. (2013), on the other hand, suggest that, when a target has a more serious information uncertainty problem caused by poor earnings quality, an acquirer would prefer to negotiate the deal with the target; and the additional information obtained through negotiations is likely to lead to a high bid premium for the target. In their view, the positive association between bid premium and the target's information uncertainty comes from the acquirer's perception of the target. Our argument is in the spirit of Cheng et al. (2016)—the high bid premium for an opaque target comes from the serious value discount on the target opaqueness by market investors. In our study, the positive association between the level of a target's information uncertainty and its bid premium is mainly driven by the market's perception of the target, not by the acquirer's perception of the target.

The remainder of this paper is structured as follows. Section 2 presents a simple valuation model to develop testing hypotheses. Section 3 describes the data and constructs the variables used in the study. Sections 4 and 5 present the key empirical results and robustness checks, respectively. Section 6 concludes our study.

2. Model and Hypotheses

To facilitate our discussion, a simple, perpetual discounted cash flow model is set as follows. Let the current stock price of the target, $P_S(\Omega)$, equal $E_T/R_S(\Omega)$, in which the price is discounting

the target's perpetual earning stream E_T (which is assumed to be constant throughout for the sake of simplicity) at the market rate, $R_S(\Omega)$, which is a positive function of the target's level of opacity, Ω. Our key assumption is that the target's share value appears differently from the acquirer's perspective, mainly because the acquirer has much richer information about the target through the due diligence process. That is to say, the discount rate used by the acquirer, $R_T(\Omega)$, would be smaller than the one used in the market—i.e., $R_T(\Omega) < R_S(\Omega)$. As such, the target's share value to its acquirer, $P_T(\Omega)$, is equal to $E_T/R_T(\Omega)$, and $P_T(\Omega) > P_S(\Omega)$.

Let us assume the total merger synergy per share, S (not to be affected by the target's information uncertainty at this point for the sake of simplicity), to be shared between the acquirer, who gets S_A, and the target, who gets S_T. As such, the bid price, $P_o(\Omega)$, is equal to $P_S(\Omega) + S_T$. That is, the acquirer needs to pay for the target on top of its current market price, $P_S(\Omega)$, certain amounts of expected synergetic gain out of the merger, S_T, which depends on the negotiation between the two parties. Hence, according to the definition, the valuation multiple should be calculated as:

$$\frac{P_O(\Omega)}{E_T} = \frac{P_S(\Omega)+S_T}{E_T} = \frac{\frac{E_T}{R_S(\Omega)}+S_T}{E_T} = \frac{1}{R_S(\Omega)} + \frac{S_T}{E_T}.$$

It is obvious that the valuation multiple is inversely related to market discount rate, $R_S(\Omega)$. This leads to our first hypothesis:

> H1: A target's valuation multiple is negatively correlated with the target's level of information uncertainty.

Notice that the bid premium frequently used in the literature is typically defined as

$$\frac{Po(\Omega)}{Ps(\Omega)} - 1 = \frac{Ps(\Omega)+S_T}{Ps(\Omega)} - 1 = \frac{S_T}{Ps(\Omega)}.$$

Since the target's market share price, $P_S(\Omega)$, will be lower if the target is more opaque, the bid premium will be positively related to the target's information uncertainty, which is our second hypothesis:

H2: The bid premium is positively correlated with the target's level of information uncertainty.

Hence, there is nothing strange in a target receiving a low valuation multiple and a high bid premium simultaneously. Our key focus, after all, is the potential value creation for the acquirer's shareholders through acquiring opaque targets. Value will be created if the value brought to the acquirer through acquiring the target of value P_T and the portion of synergy received, S_A, is larger than the cost of buying the target at its (discounted) market price, P_S, and the portion of synergy shared with the target, S_T. This potential value created is typically measured by the acquirer's market return upon the acquisition announcement, ACAR, assuming the market is efficient. As an acquirer's share price is the sum of future cash flow discounted at a certain rate, acquirer announcement return can be obtained with the following equation, where P_B is the acquirer's share price before the bid announcement:

$$ACAR(\Omega) = \frac{(P_T(\Omega)+S_A)-(P_S(\Omega)+S_T)}{P_B} = \frac{(P_T(\Omega)-P_S(\Omega))+(S_A-S_T)}{P_B}.$$

Hence, ACAR consists of two components. The information uncertainty component (i.e., $P_T(\Omega) - P_S(\Omega)$) captures the value created by the acquirer through the due diligence process. Through this process, the information uncertainty between the acquirer and the target is greatly reduced and hence the target priced by the acquirer, $P_T(\Omega)$, is higher than the target priced by the market, $P_S(\Omega)$. Because of this information uncertainty component, ACAR should always be positive. If the synergetic sharing component of ACAR (i.e., $S_A - S_T$), which captures the total synergy shared between the acquirer and the target, is also positive, then we can propose the following hypothesis:

> H3a: An acquirer's announcement return is positively correlated with the target's level of information uncertainty.

We argue that this is likely the case. First, so long as this synergetic sharing component is independent of the target's information uncertainty level, then the target's information uncertainty will affect ACAR only through the first term. Second, even if the expected synergetic gain gets discounted due to the target's information uncertainty, the acquirer will discount less than the market does due to the information advantage of the acquirer on its target over the market through its due diligence effort. That is to say, $(S_A - S_T) > 0$.

Notice that ACAR can be expressed as follows:

$$ACAR(\Omega) = \frac{(P_T(\Omega)+S_A)-(P_S(\Omega)+S_T)}{P_B} = \left(\frac{P_T(\Omega)+S_A}{E_T} - \frac{P_S(\Omega)+S_T}{E_T}\right) * \frac{E_T}{P_B}.$$

As the second term inside the parentheses is the valuation multiple, we have a related hypothesis:

H3b: An acquirer's announcement return is negatively correlated with the target's valuation multiple.

Perhaps it may be worthwhile to use our simple model to suggest a possible reason why ACAR(Ω) is frequently found to be non-positive in the literature. It could be due to the second term, synergetic sharing component, $(S_A - S_T)$, which captures the total synergy shared between the acquirer and the target. Notice that the synergy paid by the acquirer to the target, S_T, is an actual payment, whereas the synergy kept by the acquirer, S_A, is only an expected value to be realized in the future. As long as the expected S_A cannot be realized to its fullest extent, which is especially possible if the acquiring CEO is entrenched or overconfident as analyzed in the literature, ACAR(Ω) could be negative.

If we further relax the assumption and let the synergetic gain be a function of the target's information uncertainty, there would be two scenarios, either $S_A(\Omega) > S_T(\Omega)$ or $S_A(\Omega) < S_T(\Omega)$. The first scenario happens when the acquirer has stronger bargaining power than the target in sharing the synergetic gain when the target is more opaque and suffers a bigger market discount of its share value. In such a case, the positive link hypothesized in H3a and the negative link hypothesized in H3b will be even stronger, as ACAR(Ω) will be more positive when the target has more serious information uncertainty problems.

The second scenario may occur when the acquirer overpays the target due to overestimation of the synergetic effect of the merger. As mentioned before, this could happen when the acquirer

has serious agency problems (Lehn and Zhao, 2006) and/or its CEO is overconfident (Malmendier and Tate, 2008). In that case, the links hypothesized in H3a and H3b could be weakened or even rejected.

H3a and H3b are thus critical in testing our basic framework, as ACAR(Ω) is observable, but not the two components embedded in it. In fact, it is very difficult—if not utterly impossible—to disentangle the two components and measure them separately. Hence, H3a and H3b provide critical—though indirect—tests for the existence of the acquisition value deriving from the information uncertainty of the target, the major proposition in our paper.

3. Data and Variables

3.1 Data Selection

The sample of acquisitions in this study comes from the Securities Data Company's (SDC) U.S. Mergers and Acquisitions Database. Data are first selected based on the following criteria: (1) the acquirer and the target are both American firms traded on the NYSE, AMEX, or NASDAQ; (2) the deal value is equal to or greater than $1 million; (3) the takeover announcement date falls between 1986 and 2015; and (4) the acquirer controls less than 50% of the target's outstanding shares before the announcement of the takeover and will control 100% of the target's shares upon the completion of bids. The requirements yield 7,768 acquisitions. Then, events are deleted for those when the time between the completion and announcement dates is more than 1,000 days. Events are also deleted for those missing the data needed to calculate the bid premium. In accordance with Officer (2003), if the absolute value of the percentage-based bid premium (see the definition of *premium* in Section 3.3) is greater than 2, the transaction is

also deleted. Applying these criteria, the sample from the SDC database is reduced to 6,106 transactions.

Next, the SDC database is merged with the ownership data from the 13F files, financial data from Compustat, stock data from CRSP, and analysts' forecast data from I/B/E/S. Like Schwert (2000), extreme outliers are excluded when the target's sales growth or market-to-book ratio is greater than 100. The requirements yield a final sample of 2,676 transactions. An acquisition is not deleted if it is missing data on the analyst forecasts.

(Insert Table 1 here)

Table 1 reports the yearly distribution for the sample used in this study. Of the 2,676 bids announced over the period 1986–2015, 894 were conducted with a cash offer; 1,237 with an equity offer; and 545 with a mixed offer of cash and equity. Of the 2,676 total bids, 2,375 were completed, and 301 failed.

3.2 Measures of Target's Information Uncertainty

Two proxies are used to measure a target's information uncertainty. The dispersion of financial analysts' forecasts on target earnings, *DISPERSION*, is calculated as the standard deviation of all earnings forecasts from the last month of the fiscal year before the takeover announcement. The analyst forecast error, *ERROR*, is calculated as the ratio of the absolute difference between the forecast earnings and the actual earnings per share in the last month of the fiscal year before the takeover announcement to the price per share at the beginning of the

month.[9]

These two proxies are widely used to measure firms' information uncertainty (e.g., Abarbanell and Lehavy, 2003; Thomas, 2002). Generally, studies find that analyst forecast dispersion and forecast error decrease when firms disclose more information. Furthermore, Elton et al. (1984) demonstrate that forecast errors are reduced as the predictions approach the end of the fiscal year. They find that nearly 84% of the forecast error in the last month can be attributed to mistaken estimations of firm-specific factors rather than economy- or industry-wide factors. This indicates that forecasts near the end of a forecasting period are particularly appropriate as proxies for information uncertainty across firms.

3.3 Definitions of Valuation Multiple, Bid Premium, and Acquirer Abnormal Return

Following the literature, we compute the valuation multiple, *OV/EBITDA*, as the ratio of the offer value, OV, to the product of the percentage of the target outstanding shares acquired by the acquirer in the transaction and the target's earnings before interest, taxes, and depreciation, and amortization of intangibles (EBITDA) at the end of the year immediately before the bid announcement.[10] Offer value is directly collected from the SDC M&A dataset (VAL), which is the total value consideration paid by the acquirer, including the amount paid for all common stock, common stock equivalents, preferred stock, debt, options, assets, warrants, and stake purchases made within six months of the announcement date of the transaction. Liabilities assumed are included in the value if they are publicly disclosed. Preferred stock is only included

[9] Variable definitions are listed in Appendix A.

[10] The results are qualitatively unchanged if OV/EBITDA is calculated as the ratio of offer value to the target's EBITDA. Here, the transaction value is normalized by the target's EBITDA but not the target's net income because EBITDA is often used as a proxy for cash flow and is more reliable for capturing a firm's operating ability than net income. In robustness checks, similar results are obtained with the P/E ratio as a measure of the valuation multiple.

if it is being acquired as part of a 100% acquisition. A high OV–EBITDA ratio indicates that the acquirer gives the target a high valuation.

As for the bid premium, *Premium*, we also follow the literature and calculate it as the premium of the acquirer's offer price relative to the target's stock price four weeks prior to the bid announcement.[11] Acquirer's cumulative abnormal return over the announcement period, ACAR, is calculated over the event window [-1, +1], where day 0 is the bid announcement day.[12] An abnormal return is defined as the market model residual, where the parameter is estimated over the [-205, -6] event window relative to the announcement day.

3.4 Construction of Control Variables

A set of control variables about deal and firm characteristics is included in the regression tests. DIVERSIFY is set to 1 if the primary business line of the acquirer is different from that of the target and 0 otherwise. The two-digit SIC codes of the primary business line of the acquirer and the target are collected from the CRSP dataset. Morck et al. (1990) find that acquirer investors respond negatively to diversifying acquisitions, indicating that acquirer managers might overpay for the target. Therefore, it is expected that DIVERSIFY is positively related to the target's bid premium received from the acquirer.

TOEHOLD is the percentage of target shares held by the acquirer prior to the takeover announcement. Gaspar et al. (2005) document that the acquirer offers a lower bid price if it owns more shares of the target prior to the takeover. It is therefore expected that TOEHOLD is

[11] The results are qualitatively unchanged if the bid premium is calculated as the acquirer's offer price relative to the target's stock price 63 days prior to the bid announcement (e.g., Chatterjee et al., 2012; Officer, 2003; Schwert, 1996) or as the target abnormal return in a trading window [-63, +126] around the bid announcement, where day 0 is the takeover announcement date (e.g., Chatterjee et al., 2012; Officer, 2003).

[12] The results are qualitatively unchanged if ACAR is calculated over the event window [-2, +2] or [-5, +5], where day 0 is the takeover announcement date.

negatively related to target's bid premium.

TENDER is a dummy variable that equals 1 if the takeover is advanced via tender offer and 0 otherwise. Berkovitch and Khanna (1991) propose a model in which a merger is a bargaining game between the acquirer and the target, and a tender offer is an auction in which acquirers arrive sequentially and compete for the target. In equilibrium, there is a unique level of synergetic gain so that an acquirer with synergetic gain below this level will not acquire the target through a tender offer. As such, acquisition via tender offer implies a high synergetic gain. Based on this model, TENDER is expected to be positively related to bid premium.

COMPETE is the number of bidders in a takeover. Several studies find that competitive bids will drive up the bid price (Varaiya and Ferris, 1987; Walkling and Edmister, 1985). Hence, COMPETE is expected to be positively related to target's bid premium received from the acquirer.

Target managerial resistance may affect the bid price and the success of the takeover. Thus, a dummy variable, HOSTILE, is included, which equals 1 if the offer is resisted by the target and 0 otherwise. Cotter and Zenner (1994) document a positive association between bid price and target managerial resistance. Therefore, it is expected that HOSTILE is positively related to the target's bid premium.

Anti-takeover provision mechanisms are helpful for target management to bargain with acquirers in takeover transactions. Therefore, a dummy variable, POISONPILL, is added that equals 1 if a target adopts a poison pill or shareholder rights plan before the takeover announcement and 0 otherwise. Existing studies (e.g., Comment and Schwert, 1995) find that target firms adopting anti-takeover provisions receive no fewer takeover offers but get higher takeover premiums. Therefore, POISONPILL is expected to be positively related to bid premium.

COMPLETE is a dummy variable that equals 1 if a takeover transaction is successfully consummated and 0 otherwise. A low bid premium is more likely to result in the failure of the takeover. Therefore, it is expected that COMPLETE is positively related to bid premium.

POOLING is a dummy variable that equals 1 if the pooling-of-interest accounting method is reported in takeovers and 0 if the takeover is accounted for by the purchase method. Robinson and Shane (1990) examine the effect of the accounting reporting method on the bid premium. They document that the bid premium tends to be higher for acquisitions recorded using the pooling method. Therefore, it is expected that POOLING is positively related to bid premium.

Berkovitch and Narayanan (1990) suggest that both the acquirer and target abnormal returns should be higher if the takeover is completed with a cash offer. Loughran and Vijh (1997) find supporting evidence for it. Therefore, the payment method CASH is included, which equals 1 for a pure cash offer and 0 for a pure stock offer or mixture offer of stock and cash. CASH is expected to be positively related to bid premium.

Betton et al. (2009) find that targets listed on the NYSE or Amex receive high bid premiums from acquirers. They also documented that public targets with penny stock prices receive low premiums from acquirers. Therefore, a dummy variable, TLISTED, is added that equals 1 if the target is listed on the NYSE or Amex prior to the takeover announcement and 0 otherwise. TLISTED is expected to be positively related to bid premium. Also, a dummy variable, PENNY, is added that equals 1 if the target's stock price is below $1 six weeks prior to bid announcement and 0 otherwise. PENNY is expected to be negatively related to bid premium.

RUNUP is the target's average cumulative abnormal return over the period [-41, -1] using a value-weighted market model estimated over the [-205, -6] event window, where day 0 is the bid announcement day. Prior studies (e.g., Schwert, 1996) show that target stock run-up is

significantly positively related to bid premium. Therefore, positive associations are expected between RUNUP and the target's bid premium received from the acquirer.

As for firm characteristics, Massa and Xu (2013) show that bid premium and announcement return increase with target liquidity. Therefore, target stock liquidity is added. Following them, the target stock liquidity index, LIQUIDINDEX, is constructed with volume, turnover, the bid-ask spread, and the liquidity ratio Amihud (based on Amihud (2002)), using a factor analysis. Volume is defined as the logarithm of the average daily number of shares traded over the [-205, -42] event window, where day 0 is the bid announcement day. Turnover is defined as the logarithm of volume standardized by the number of shares outstanding. The bid-ask spread is obtained as the daily relative bid-ask spread averaged over the [-205, -42] event window, where the daily relative spread is the ratio of the absolute value of the bid-ask spread over the midpoint of the spread. Following Amihud (2002), the liquidity ratio is the aggregate ratio of daily absolute returns to daily dollar trading volumes over the [-205, -42] event window. It is expected that LIQUIDINDEX is positively related to bid premium.

MTB is the ratio of the target market value of common stock to the book value of equity at the end of the fiscal year before the takeover announcement. Dong et al. (2006) show that targets with high market-to-book ratios receive low premiums from acquirers. Therefore, it is expected that MTB is negatively related to bid premium.

ROA is the ratio of the target's net income to total assets at the end of the year prior to the takeover announcement. GROWTH is the target's proportional change in sales in the year before the takeover announcement. Studies (e.g., Cheng et al., 2016; Raman et al., 2013) show that targets with high performance receive high bid premiums from acquirers. Therefore, it is expected that ROA and GROWTH are positively related to bid premium.

ASIZE is the logarithm of the acquirer's market value of common equity at the end of the fiscal year before the takeover announcement. RSIZE is the ratio of the target's market value of common equity to that of the acquirer at the end of the fiscal year before the takeover announcement. Several studies (e.g., Bhagat et al., 2005) find that the relative size of the target to the acquirer is negatively related to the target announcement return, indicating that a larger acquirer may bid a higher price in the acquisition of a smaller target. Therefore, it is expected that ASIZE is positively related to bid premium. By contrast, RSIZE is expected to be negatively related to bid price.

REGULATE is a dummy variable that equals 1 if the target belongs to the financial, real estate, and trade industries and 0 otherwise. Boone and Mulherin (2007) show that targets in regulated industries receive low premiums. Therefore, REGULATE is expected to be negatively related to bid premium.

As for governance mechanisms, OWNERSHIP is included in the test as the number of institutional blockholders owning more than 5% of a target's shares at the end of the year prior to the takeover announcement. It is expected that OWNERSHIP is positively related to bid price, given that large shareholders can actively monitor the behavior of target managers, and targets with good governance receive high bid premiums in takeover transactions (e.g., Massa and Xu, 2013). Moreover, the ownership concentration of a target's institutional blockholders is included in the test. Ownership concentration is measured with the Herfindahl-Hirschman index, HHINDEX, which is expected to be negatively related to bid price. Data about institutional ownership are collected from 13F files.

3.5 Data Description

(Insert Table 2 here)

Table 2 reports the descriptive statistics about the whole sample and the sub-sample of completed bids. Look at the whole sample. The average analyst forecast DISPERSION is 0.009, and the average forecast ERROR is 0.025. The target's average percentage-based bid premium is 0.394. As for the valuation multiple, OV/EBITDA, the average offer value is 8.89 times the target's EBITDA. On average, the acquirer suffers a loss of 0.9% around the announcement of the takeover (ACAR).

(Insert Table 3 here)

Table 3 reports the Pearson correlations among the variables. As shown, while forecast ERROR and forecast DISPERSION are significantly positively related to bid PREMIUM, they are significantly negatively related to OV/EBITDA. This correlation provides initial evidence that, despite a high bid premium, a target with high information uncertainty actually receives a low valuation multiple.

The coefficient of Pearson correlation between PREMIUM and OV/EBITDA is 0.04 without statistical significance (p-value = 0.252). This evidence shows that there is no significant relationship between bid premium and valuation multiple.[13]

ACAR is significantly positively related to forecast ERROR and forecast DISPERSION. On the other hand, ACAR is significantly negatively related to PREMIUM and OV/EBITDA,

[13] We also conduct a set of robustness tests, and the results show that there is no constant relationship between bid premium and valuation multiple.

indicating that investors respond negatively to an acquisition if the acquirer pays a high price to the target.

4. Empirical Tests

4.1 Target Valuation

4.1.1 Univariate Test

To begin the analysis, a univariate analysis is performed on the linkage of the target's information uncertainty and bid price. Specifically, the analyst forecast DISPERSION and forecast ERROR are sorted separately in ascending order and then divided into five quintiles to check the average and median value of bid premium and valuation multiple within each quintile.

(Insert Table 4 here)

Table 4 reports the results sorted with analyst forecast DISPERSION in Panel A and forecast ERROR in Panel B. The sorting results reveal several interesting facts about the bid premium and valuation multiple. First, the bid premium almost invariably increases monotonically with the target's information uncertainty level. Second, the valuation multiple almost invariably decreases monotonically with the information uncertainty level. Third, for both bid premium and valuation multiple, there is a significant difference between the top and bottom quintiles, as shown in the bottom row of the panel. For instance, in Panel A, the average *Premium* is 0.354 for targets in quintile Q1, with the lowest forecast dispersion, which is

significantly lower (*p*-value = 0.048) than 0.391 for those in quintile Q5, with the highest dispersion. On the other hand, the average OV/EBITDA is 12.9 for targets in quintile Q1, which is significantly higher (*p*-value < 0.001) than 5.97 for those in quintile Q5. Clearly, a target with a high level of information uncertainty receives a high bid premium from the acquirer. However, this does not mean that the acquirer overbids for the target, as the acquirer evaluates the target lower and gives the target a lower valuation multiple in the transaction.

4.1.2 Regression Results

After the univariate analysis, we then conduct multiple regressions on the association of bid price and target information uncertainty, using the following model:

$$Premium_{i,}\ OV/EBITDA_i = a_o + a_1 * Information\ Proxy_i + a_2 * Control\ Variables_i + a_3 * Industry\ Dummy_i + a_4 * Year\ Dummy_i + error_i \quad (1).$$

The dependent variable is either the bid premium, *Premium*, or the valuation multiple, OV/EBITDA. The independent variables include the proxy of information uncertainty, DISPERSION or ERROR, and a group of control variables including the deal characteristics and firm characteristics mentioned earlier. Regressions are run separately on bid premium and valuation multiples with 1% outliers of the continuous, dependent, and independent variables being winsorized. Year and industry dummies are included in the regression. Industries are classified according to the three-digit SIC codes collected from the CRSP dataset. The regression results are presented in Table 5.

(Insert Table 5 here)

As shown in specifications (1) and (3), both the forecast DISPERSION and ERROR are significantly positively correlated with the bid *Premium*, with estimated coefficients of 3.25 (*p*-value of 0.066) and 0.26 (*p*-value of 0.042), respectively. This result confirms earlier studies, which state that targets with a high level of information uncertainty receive high bid premiums.

On the other hand, specifications (2) and (4) show that the forecast DISPERSION and ERROR are significantly negatively correlated with OV/EBITDA, with estimated coefficients of –37.2 and –24.8, respectively, and both *p*-values being less than 0.001, indicating that acquirers give a low valuation multiple to targets with a high level of information uncertainty.

As for deal and firm characteristics, the variables are generally significantly correlated with the bid premium and valuation multiple, as expected. Overall, even after controlling for the deal and target characteristics, targets with a high level of information uncertainty tend to receive high bid premiums in takeovers, confirming our second hypothesis, H2. Notwithstanding the high bid premiums, targets with high information uncertainty actually receive a low valuation from acquirers, as measured with the valuation multiple, confirming our first hypothesis, H1.

4.2 Acquirer Announcement Return

Our next and key set of tests is to see if such bidding behaviors are beneficial to shareholders, as reflected in ACAR. Specifically, if the acquirer bids too high for the target, the acquirer's stock price should drop, leading to a negative association between ACAR and the valuation multiple given to the target.

4.2.1 Univariate Test

Again, we start with a univariate analysis on the linkage of the target's information uncertainty with ACAR by dividing the firms into five quintiles according to information uncertainty level to check the average and median value of ACAR within each quintile.

(Insert Table 6 here)

Panel A of Table 6 presents the ACAR sorted with analyst forecast DISPERSION. Clearly, ACAR increases almost monotonically with forecast dispersion for the whole sample, the sample of cash offers, and the sample of non-cash offers. The evidence is consistent with the findings of Chatterjee et al. (2012) and Cheng et al. (2016).

Notice that, although investors respond more positively to cash offers than non-cash offers, as is well-documented in the literature, the monotonic pattern remains in both payment types. That is to say, the increase in ACAR with an increase in target opacity holds in general, regardless of the payment method.

In Panel B, ACAR also increases monotonically with forecast ERROR for the whole sample, the sample of cash offers, and the sample of non-cash offers. In Panel C, ACAR is sorted by the valuation multiple. Clearly, there is a decreasing trend for ACAR with the valuation multiple. Again, for both cash offers and non-cash offers, ACAR decreases almost monotonically with the valuation multiple, OV/EBITDA.

Collectively, the evidence shows that investors respond positively (or less negatively) when acquirers bid for targets with more information uncertainty, providing some tentative support to Hypothesis H3a. The evidence also shows that investors respond positively (or less negatively)

when acquirers give a low valuation multiple to acquire the targets, providing tentative support to Hypothesis H3b.

4.2.2 Regression Results

To get more evidence, we run multiple regressions on the acquirer announcement return with the following model, putting in important control variables:

$$ACAR_i = b_o + b_1 * OV/EBITDA_i + b_2 * Information\ Proxy_i + b_3 * Control\ Variables_i + b_4 * Industry\ Dummy_i + b_5 * Year\ Dummy_i + error_i \quad (2).$$

The dependent variable in model (2) is ACAR. The independent variables include the valuation multiple, OV/EBITDA, and the information uncertainty proxy, DISPERSION or ERROR. The control variables are the same as those used in model (1), except that return on asset, sales growth, and market-to-book ratio are now of the acquirer and not of the target. Specifically, AROA is the ratio of the acquirer's net income to total assets at the end of the year prior to the takeover announcement. AGROWTH is the acquirer's proportional change in sales in the year before takeover announcement. AMTB is the ratio of the market value of the acquirer's common stock to the book value of equity at the end of the year before the takeover announcement. Table 7 reports the regression results.

(Insert Table 7 here)

In specification (1), controlling for deal characteristics and acquirer firm characteristics, the

valuation multiple, OV/EBITDA, is significantly negatively related to ACAR, with an estimated coefficient of –0.013 and a *p*-value of 0.018, indicating that acquirers realize high returns when they give a low valuation to acquire targets. Note that the bid premium, *Premium*, is significantly negatively related to the acquirer abnormal return in the regression, indicating that acquirer investors respond negatively if the acquirers pay high premiums to acquire their targets.

In specification (2), forecast DISPERSION is significantly positively related to ACAR, with an estimated coefficient of 0.02 and a *p*-value of 0.075. Similarly, in specification (3), forecast ERROR is also significantly positively related to the acquirer announcement return, with an estimated coefficient of 0.15 and a *p*-value of 0.060.

In specifications (4) and (5), the regression is run by putting in the valuation multiple and proxies of information uncertainty together. As shown in both regressions, OV/EBITDA is significantly negatively related to the acquirer announcement return, again confirming that the acquirers realize high returns if they acquire targets with a low valuation multiple in takeover transactions.

In summary, the regression results clearly show that, even after controlling for deal characteristics and target firm characteristics, target information uncertainty is still found to be positively correlated with acquirer's announcement abnormal return, and the valuation multiple is still found to be negatively correlated with the acquirer's announcement abnormal return. Hence, we have strong evidence in support of Hypotheses H3a and H3b.

5. Robustness Tests

We have established two basic sets of results on the target's valuation multiple and the

acquirer's announcement returns. In this section, we conduct a series of tests to assure that our results are robust. The first set of robustness tests is about the association between valuation multiple and target information uncertainty, and the second set is about the linkage between acquirer announcement return and target information uncertainty.

5.1 The Link between Valuation Multiple and Target Information Uncertainty

5.1.1 Acquirer's Managerial Overconfidence

Roll (1986) argues that a manager infected by hubris may inadvertently overestimate her ability, actively and aggressively participate in takeovers, and consequently overpay for the target. Hayward and Hambrick (1997) provide some empirical evidence. Malmendier and Tate (2005, 2008) also empirically examine the effects of CEO overconfidence on takeover activities. They find that overconfident CEOs overinvest and conduct more mergers when they have abundant internal funds, but curtail investment when they require external financing. Hence, our previous finding of higher bid premiums for more opaque targets may be driven by the acquirer's hubris or overconfidence.

To cater to such a possibility, we follow the literature and construct two CEO overconfidence measures. The first is constructed based on the CEO's stock option exercising manner. Malmendier and Tate (2005) define CEOs as overconfident if they hold options that exceed 67% in the money. We follow Campbell et al. (2011) to define a CEO as overconfident if she holds options at 100% or more in the money.[14]

The second measure is constructed based on the CEO's share purchase. Malmendier and

[14] Please refer to Campbell et al. (2011) for the construction details. The results remain qualitatively the same if Malmendier and Tate's (2005) cutoff of 67% moneyness is used to define overconfidence.

Tate (2005) find that overconfident CEOs often purchase additional stock despite already owning a large number of shares in the firm. We follow them and define a CEO as overconfident if her net share purchase is positive throughout her entire tenure at a firm. Data regarding managerial share purchase and sales are collected from the Thomson Financial Insider Transactions database.

Again, we start with sorting the bid premium by the target's level of information uncertainty based on acquirer CEO overconfidence. As before, forecast DISPERSION or ERROR is sorted in ascending order and then divided into five quintiles to check the average and median values of bid premium within each quintile. A similar sorting is also done on target's valuation multiple, OV/EBITDA. The results are reported in Panel A of Table 8.

(Insert Table 8 here)

As the sorting results reveal, the bid premium almost invariably increases monotonically, and the valuation multiple decreases monotonically with the information uncertainty level, regardless of whether CEOs are overconfident or not. Interestingly, compared to their overconfident peers, non-overconfident CEOs tend to give both a higher bid premium and a higher valuation on less opaque targets, but they turn more conservative and give a lower bid premium and valuation on more opaque targets.

Panel B of Table 8 reports the corresponding regression results in which two overconfidence measures are added into regression model (1) and interact with the two information uncertainty proxies.[15] As shown in the bid-premium panel, DISPERSION enters positively in specifications (1) and (2), with coefficients of 2.65 (*p*-value of 0.015) and 3.07 (*p*-

[15] To save space, the coefficient estimates of the control variables are not reported, as well as for all the regression tables reported in the subsequent robustness tests.

value of 0.078), respectively. Its interactions with the two measures of overconfidence also enter positively into the regressions, with coefficients of 0.52 (*p*-value of 0.049) and 0.08 (*p*-value of 0.081), respectively. Another information uncertainty proxy, ERROR, posts a similar picture, except its interactions with the two measures of overconfidence do not enter significantly into specifications (3) and (4).

Overall, overconfident CEOs tend to pay a higher premium on more opaque targets, but more importantly, the positive correlation between bid premium and target information uncertainty generally holds irrespective of CEO overconfidence.

As for the results shown in the right-hand panel on valuation multiple, there is a clear pattern that the sensitivity of valuation multiple to information uncertainty decreases for overconfident acquirers. Take specification (5) as an example. Forecast DISPERSION is significantly negatively related to valuation multiple, with an estimated coefficient of –43 (*p*-value of 0.022). Nonetheless, the interaction of DISPERSION with Overconfidence1 is significantly positive, with an estimated coefficient of 29 (*p*-value<0.001). This evidence shows that the sensitivity of valuation multiple to information uncertainty decreases for overconfident CEOs, although overconfident CEOs still give a low valuation multiple (coefficient equals –14, i.e., –43 + 29) to targets with high information uncertainty. The situations are similar in the other three specifications.

Collectively, the results reconfirm our earlier findings that acquirers give lower valuation to targets with higher information uncertainty, no matter if the acquirers are overconfident or not, although it is indeed the case that, relative to non-overconfident CEOs, overconfident CEOs in acquiring firms tend to give a higher valuation to targets with high information uncertainty.[16]

[16] We do not find that overconfident CEOs offer either a higher bid premium or a higher valuation multiple to the whole sample of targets than non-overconfident CEOs. As shown in Panel B in Table 8, in

5.1.2 Endogeneity

The endogeneity problem is always a tough issue in empirical studies. Our finding of a negative association between valuation multiple and target information uncertainty may be driven by certain variables omitted in regression model (1). Furthermore, acquirers with certain characteristic may prefer to select targets with high information uncertainty.[17] To address these issues, we collect a sample of 107 targets that are not successfully acquired in the initial bids but whose acquisitions are successfully consummated in subsequent bids over the sample period. In this sample, there are 214 bids announced in different years for each of the 107 targets, which can be taken as a time-series sample data. With this panel-data sample, we can then run regression model (1) again by controlling the target's firm-fixed effects.

(Insert Table 9 here)

Panel A of Table 9 reports the regression results for the sample of 214 bids. As shown, both forecast DISPERSION and forecast ERROR are significantly negatively related to valuation multiple. This evidence shows that the negative association between valuation multiple and information uncertainty is unlikely to be driven by omitted variables.

Our panel-data sample also enables us to address the reverse causality problem. Specifically, we compute the change in valuation multiple and regress it on the change of information uncertainty level for the 107 initially unsuccessful takeover targets. The regression results are reported in Panel B of Table 9. In specification (1), the change in forecast dispersion

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general, the coefficients of Overconfidence1 and Overconfidence2 are not statistically significant.

[17] We thank the referee for pointing out this.

(ΔDISPERSION) is significantly negatively related to change in valuation multiple (ΔOV/EBITDA), with an estimated coefficient of –15 and a *p*-value of 0.095. In specification (2), the change of forecast error (ΔERROR) is significantly related to ΔOV/EBITDA, with an estimated coefficient of –28 and a *p*-value of 0.038. This evidence confirms that an increase in the target's level of information uncertainty can cause a decrease in the valuation multiple received from the acquirer.[18]

5.1.3 Alternative Measures for Information Uncertainty

In addition to analyst forecast dispersion and forecast error, several proxies are also used to measure a target's level of information uncertainty. The first proxy is the bid-ask spread. Many studies document that firms with larger bid-ask spreads have higher levels of information uncertainty (e.g., Affleck-Graves et al., 2002; Leuz and Verrecchia, 2000; Welker, 1995). Specifically, SPREAD is obtained as the daily relative bid-ask spread averaged over the fiscal year before the announcement of the takeover, where the daily relative spread is the ratio of the absolute value of the bid-ask spread over the midpoint of the spread.

The second proxy is the idiosyncratic volatility of the target stock. Idiosyncratic volatility is widely used in the finance literature to measure a firm's information uncertainty level (e.g., Dierkens, 1991; Moeller et al., 2007). Studies document that a firm with high volatility exhibits a high level of information uncertainty. Specifically, in this study, idiosyncratic VOLATILITY is calculated as the standard deviation of the target's daily abnormal stock return from the 365 days prior to 63 days until the takeover announcement date.

[18] Brous and Kini (1993) examine analysts' earnings forecasts for a sample of takeover targets. They find that the announcement-month forecasts are systematically revised upward, indicating that a takeover announcement conveys favorable information about the target firm.

(Insert Table 10 here)

Panel A in Table 10 reports the valuation multiple sorted by two alternative proxies of target information uncertainty. For both proxies, there is a decreasing trend of valuation multiple with target information uncertainty. The differences between quintile Q1 and quintile Q5 are statistically significant.

Panel B reports the regression results of valuation multiple on alternative proxies of information uncertainty. OV/EBITDA is significantly negatively related to SPREAD and VOLATILITY. The results confirm again a negative association of the target's valuation multiple and information uncertainty level.

5.1.4 Alternative Measures for Valuation Multiple

Other than OV/EBITDA, we have also tried on several other valuation multiples. The first is the industry-adjusted valuation ratio, OV/EBITDA_adj.[19] It is the difference of OV/EBITDA (as defined before) and $\widehat{M}$/EBITDA, where $\widehat{M}$ is the fitted value of M from the following regression:[20]

$$Ln(M_{it}) = c_0 + c_1 \ln(B_{it}) + c_2 \ln(EBITDA_{it}^{+}) + c_3 I_{(<0)} \ln(EBITDA_{it}^{+}) + c_4 Lev_{it} + \varepsilon_{it} \quad (3).$$

where $Ln(M_{it})$ is the natural logarithm of market value of equity for firm *i* in year *t*; $\ln(B_{it})$ is the natural logarithm of book value of equity for firm *i* in year *t*; $\ln(EBITDA_{it}^{+})$ is the natural logarithm of the absolute value of earnings before interest, taxes, and depreciation and

[19] We thank the associate editor for pointing this out for us.
[20] Please refer to Appendix B for the details of the construction.

amortization of intangibles (EBITDA) for firm i in year t; $I_{(<0)}\ln(EBITDA_{it}^{+})$ is an indicator function for negative EBITDA, and Lev_{it} is the ratio of total debt to total equity for firm *i* in year *t*.

The other multiples are the offer value relative to various measures of target enterprise value. Specifically, Offer/EV is obtained as the offer value relative to the entire economic value of a target firm. Economic value is the theoretical takeover price that an acquirer would have to pay to buy a target. Offer/BV is the ratio of offer value to the book value of the target's equity. Offer/Sale is the ratio of offer value to the target's sales.[21]

(Insert Table 11 here)

Panel A in Table 11 presents the alternative measures of valuation multiple sorted by analyst forecast dispersion and forecast error. All valuation multiples almost decrease monotonically with information uncertainty. Take forecast error for an example. The average industry-adjusted price-to-earnings ratio is 5.01 for targets with the lowest forecast error in quintile Q1, while it is 2.21 for targets with the highest forecast error in quintile Q5. On average, the offer value equals 1.19 times the target's enterprise value for targets having the lowest forecast error. Yet, the average offer value is only 0.85 times the target's enterprise value for targets with the highest forecast error. The differences of the valuation multiple are statistically significant.

Panel B reports the regression results of alternative measures of valuation multiple on information uncertainty. As shown, all multiples are significantly negatively related to

[21] Damodaran (2002) points out that sales and/or book value may be more useful valuation fundamentals when earnings are negative.

information uncertainty proxies. The evidence shows again a decreasing trend of the valuation multiple with the target's level of information uncertainty.

5.1.5 Other Tests

Other robustness tests are also conducted. (1) The sample is divided according to some factors that may affect the acquirer's valuation of the target, including deal attitude, payment method, acquisition form, whether the takeover is a diversifying transaction, and whether the takeover is successfully completed. (2) Some exceptional cases are deleted that may contaminate the results. Specifically, unsuccessful bids are excluded. Then, targets with negative accounting performance (net income) at the end of the year before the takeover are deleted. Finally, bids with a target price below $2 per share 63 days prior to the takeover announcement are excluded, considering that these firms are likely to be more affected by market microstructure effects (Ball et al., 1995). (3) Targets with an analyst following of less than four are deleted, considering that the dispersion of analyst forecasts would be higher if there are fewer analysts following the firm.

(Insert Table 12 here)

Panel A in Table 12 presents the sorting results of the robustness tests. For brevity, only results of OV/EBITDA sorted by forecast DISPERSION are reported. As shown, for all of the robustness tests, targets with a high forecast dispersion in quintile Q5 receive a lower valuation multiple than those with a low forecast dispersion in quintile Q1. The valuation difference between the two quintiles is statistically significant.

Panel B reports the regression results of robustness tests. For brevity, only the coefficient of

forecast DISPERSION is reported. As shown, in all specifications, forecast DISPERSION is significantly negatively related to valuation multiple. These results clearly indicate a negative association between a target's level of information uncertainty and its valuation received in takeover transactions.

5.2 The Link between ACAR and Target Information Uncertainty

(Insert Table 13 here)

Our next set of robustness tests is on acquirer announcement return, ACAR. We first re-run the regressions with a more restrictive, completed takeover sample. Our initial sample includes all takeover announcements, but some of them ended up failing. Hence, we want to make sure that our results are not biased by the incomplete takeover cases, and the results are presented in Panel A of Table 13.

Second, Moeller et al. (2004) document that large acquirers suffer a significant loss from acquisitions. Therefore, the sample is divided into two groups based on the median value of ASIZE. In particular, the impact of target valuation multiple on the acquisition return is checked for those large acquirers whose value is above the median, and the results are presented in Panel B of Table 13.

The third test is on dividing the sample according to the payment methods. The takeover literature documents that ACAR tends to be higher for acquisitions paid by cash (e.g., Chang, 1998). The results are presented in Panel C of Table 13.

Our final test is on dividing the sample according to whether the acquisition form is a tender

offer or not, as tender offers are found to give a downward pressure on ACAR (e.g., Bhagat et al., 2005). The results are presented in Panel D of Table 13.

As shown in the various panels of Table 13, all regressions confirm that the valuation multiple, OV/EBITDA, is significantly negatively related to ACAR, whereas the two target information uncertainty proxies, DISPERSON and ERROR, are significantly positively related to ACAR, irrespective of the completion of the deal, the size of the acquirer, the payment method, and the acquisition form.

6. Conclusion

This study examines how a target's information uncertainty level affects an acquirer's valuation of the target and the gain realized from the transaction. With a simple, perpetual discounted cash flow model, we propose that a target with a high level of information uncertainty obtain a high bid premium but a low valuation multiple from an acquirer. Furthermore, the acquirer announcement return could be negatively related to the valuation multiple but positively related to target information uncertainty.

The empirical findings lend support to our propositions. Specifically, we observe that bid premium and acquirer announcement returns are positively correlated with target's information uncertainty, whereas valuation multiple is negatively correlated with target's information uncertainty and acquirer announcement returns. Our results are robust against various measurements of valuation multiples and information uncertainty.

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Table 1
Sample Distribution by Announcement Year

This table presents the yearly distribution of the 2,676 mergers and acquisitions announced between 1986 and 2015. In the sample, both the acquirer and the target are American firms traded on the NYSE, AMEX, or NASDAQ; the deal value is equal to or greater than $1 million; and the acquirer controls less than 50% of the target's outstanding shares before the announcement of the takeover and will control 100% of the target's shares upon the completion of bids.

	Cash Offer	Mixture Offer	Equity Offer	Completed Bids	Whole Sample
1986	24	3	7	25	34
1987	20	6	11	32	37
1988	41	14	21	59	76
1989	25	6	22	38	53
1990	13	5	12	26	30
1991	7	5	17	21	29
1992	9	1	18	24	28
1993	9	7	30	34	46
1994	17	8	24	38	49
1995	31	12	69	99	112
1996	29	19	87	121	135
1997	34	52	97	165	183
1998	52	41	93	164	186
1999	57	39	98	169	194
2000	47	21	64	115	132
2001	33	33	53	108	119
2002	26	22	27	70	75
2003	32	27	30	82	89
2004	33	28	38	91	99
2005	31	22	43	90	96
2006	30	19	35	76	84
2007	35	18	36	80	89
2008	28	18	26	69	72
2009	38	16	32	81	86
2010	34	14	37	79	85
2011	31	22	39	88	92
2012	37	10	43	83	90
2013	28	21	46	89	95
2014	32	19	37	76	88
2015	31	17	45	83	93
Total	894	545	1,237	2,375	2,676

Table 2
Descriptive Statistics of the Variables

This table presents the descriptive statistics of the variables used in this study. The definitions of the variables are provided in Appendix A.

	Whole Sample			Completed Takeovers		
	Number	Mean	Median	Number	Mean	Median
OV/EBITDA	2,676	8.89	8.27	2,375	9.21	8.39
PREMIUM	2,676	0.394	0.327	2,375	0.405	0.332
ACAR	2,676	–0.009	–0.006	2,375	–0.009	–0.006
DISPERSION	2,334	0.009	0.003	2,045	0.009	0.003
ERROR	2,513	0.025	0.014	2,206	0.024	0.014
DIVERSIFY	2,676	0.73	1	2,375	0.73	1
TOEHOLD	2,676	0.33	0.21	2,375	0.34	0.21
TENDER	2,676	0.18	0	2,375	0.19	0
COMPETE	2,676	1.09	1	2,375	1.05	1
TLISTED	2,676	0.27	0	2,375	0.27	0
HOSTILE	2,676	0.15	0	2,375	0.11	0
PENNY	2,676	0.12	0	2,375	0.11	0
POOLING	2,676	0.14	0	2,375	0.16	0
CASH	2,676	0.33	0	2,375	0.33	0
REGULATE	2,676	0.26	0	2,375	0.27	0
COMPLETE	2,676	0.89	1	2,375	1	1
RUNUP	2,676	0.097	0.072	2,375	0.104	0.076
MTB	2,676	2.38	1.66	2,375	2.40	1.68
ROA	2,676	0.03	0.04	2,375	0.03	0.04
GROWTH	2,676	0.29	0.12	2,375	0.28	0.11
LIQUIDINDEX	2,676	2.48	2.41	2,375	2.47	2.41
ASIZE	2,676	7.45	7.29	2,375	7.63	7.49
RSIZE	2,676	0.71	0.70	2,375	0.70	0.69
POISONPILL	2,676	0.07	0	2,375	0.08	0
HHINDEX	2,676	0.17	0.12	2,375	0.18	0.12
OWNERSHIP	2,676	0.37	0.33	2,375	0.38	0.33

Table 3
Pearson Correlations among Variables

This table shows the Pearson correlations among variables. The definitions of the variables are provided in Appendix A. The *p*-value is reported in parentheses.

	OV/EBITDA	PREMIUM	ACAR	DISPERSION	ERROR	DIVERSIFY	TOEHOLD	TENDER	COMPETE	TLISTED	HOSTILE	PENNY	POOLING
PREMIUM	0.04 (0.252)												
ACAR	–0.06 (0.017)	–0.05 (0.021)											
DISPERSION	–0.04 (<.001)	0.05 (0.040)	0.07 (0.003)										
ERROR	–0.05 (<.001)	0.02 (0.037)	0.06 (0.005)	0.32 (<.001)									
DIVERSIFY	0.01 (0.601)	0.02 (0.410)	–0.001 (0.062)	0.06 (0.003)	–0.003 (0.839)								
TOEHOLD	–0.002 (0.011)	–0.08 (<.001)	0.03 (0.018)	0.04 (0.029)	0.02 (0.301)	0.03 (0.075)							
TENDER	–0.0001 (0.997)	0.17 (<.001)	0.08 (<.001)	0.02 (0.389)	–0.02 (0.199)	0.06 (<.001)	0.09 (<.001)						
COMPETE	0.04 (0.022)	0.11 (<.001)	0.03 (0.185)	0.06 (<.001)	0.02 (0.190)	0.03 (0.054)	–0.04 (0.010)	0.13 (<.001)					
TLISTED	0.01 (0.338)	0.06 (0.253)	0.06 (0.003)	0.19 (<.001)	0.06 (<.001)	0.12 (<.001)	0.11 (<.001)	0.10 (<.001)	0.06 (<.001)				
HOSTILE	–0.01 (0.610)	–0.06 (0.136)	0.06 (0.002)	0.09 (<.001)	–0.01 (0.376)	0.09 (<.001)	0.07 (<.001)	0.08 (<.001)	0.17 (<.001)	0.22 (<.001)			
PENNY	–0.01 (0.021)	–0.13 (0.061)	0.01 (0.565)	0.10 (<.001)	0.14 (<.001)	0.08 (<.001)	0.02 (0.345)	0.04 (0.032)	0.004 (0.827)	0.17 (<.001)	0.09 (<.001)		
POOLING	0.07 (<.001)	0.04 (0.019)	–0.13 (<.001)	–0.08 (<.001)	–0.07 (<.001)	-0.06 (<.001)	–0.10 (<.001)	–0.19 (<.001)	–0.05 (0.004)	–0.09 (<.001)	–0.16 (<.001)	–0.06 (<.001)	
CASH	–0.01 (0.696)	0.07 (<.001)	0.14 (<.001)	0.001 (0.959)	0.01 (0.716)	0.08 (<.001)	0.07 (<.001)	0.41 (<.001)	0.05 (0.002)	0.07 (<.001)	0.22 (<.001)	–0.03 (0.084)	–0.32 (<.001)

(Continued)

Table 3—Continued

	OV/EBITDA	PREMIUM	ACAR	DISPERSION	ERROR	DIVERSIFY	TOEHOLD	TENDER	COMPETE	TLISTED	HOSTILE	PENNY	POOLING
REGULATE	–0.0001	–0.10	–0.004	0.0003	–0.07	–0.001	–0.01	–0.21	–0.01	–0.04	–0.08	–0.04	0.07
	(0.999)	(<.001)	(0.852)	(0.988)	(<.001)	(0.987)	(0.504)	(<.001)	(0.495)	(0.013)	(<.001)	(0.022)	(<.001)
COMPLETE	0.02	0.02	0.02	–0.05	–0.04	–0.04	0.004	0.04	–0.28	–0.06	–0.27	–0.05	0.08
	(0.374)	(0.225)	(0.253)	(0.008)	(0.024)	(0.011)	(0.812)	(0.028)	(<.001)	(<.001)	(<.001)	(0.004)	(<.001)
RUNUP	0.03	0.35	0.04	–0.02	–0.07	–0.01	–0.08	0.12	0.05	0.003	–0.04	–0.002	0.06
	(0.196)	(<.001)	(0.092)	(0.378)	(<.001)	(0.773)	(<.001)	(<.001)	(0.005)	(0.857)	(0.025)	(0.896)	(<.001)
MTB	0.04	–0.05	–0.05	–0.06	–0.12	–0.04	–0.02	–0.01	–0.05	–0.11	–0.03	–0.08	0.07
	(0.035)	(0.004)	(0.021)	(0.002)	(<.001)	(0.012)	(0.228)	(0.401)	(0.002)	(<.001)	(0.055)	(<.001)	(<.001)
ROA	0.02	0.014	–0.06	–0.06	–0.11	0.02	0.0001	–0.01	–0.004	0.05	0.03	–0.01	0.02
	(0.016)	(0.131)	(0.004)	(0.002)	(<.001)	(0.321)	(0.998)	(0.673)	(0.781)	(0.005)	(0.118)	(0.445)	(0.161)
GROWTH	0.04	0.01	–0.06	–0.05	–0.02	–0.02	–0.01	–0.04	–0.03	–0.12	–0.04	0.01	0.06
	(0.061)	(0.044)	(0.004)	(0.006)	(0.195)	(0.243)	(0.742)	(0.011)	(0.095)	(<.001)	(0.031)	(0.616)	(<.001)
LIQUIDINDEX	–0.01	0.05	–0.11	0.02	0.03	–0.04	–0.06	0.05	0.02	–0.07	0.04	–0.04	–0.04
	(0.024)	(0.020)	(<.001)	(0.343)	(0.106)	(0.045)	(0.001)	(0.010)	(0.381)	(<.001)	(0.060)	(0.063)	(0.030)
ASIZE	–0.02	0.05	0.05	–0.04	–0.03	0.08	–0.01	0.02	–0.05	–0.09	–0.08	–0.06	–0.10
	(0.061)	(0.012)	(0.015)	(0.114)	(0.168)	(<.001)	(0.617)	(0.264)	(0.017)	(<.001)	(<.001)	(0.003)	(<.001)
RSIZE	0.03	–0.19	–0.08	0.04	–0.16	–0.05	0.10	–0.07	0.10	0.22	0.22	0.06	–0.003
	(0.161)	(<.001)	(<.001)	(0.095)	(<.001)	(0.028)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(0.002)	(0.883)
POISONPILL	0.04	0.04	–0.05	–0.04	0.001	–0.03	–0.07	0.02	–0.02	–0.02	–0.02	–0.03	0.23
	(0.065)	(0.071)	(0.044)	(0.064)	(0.969)	(0.107)	(0.002)	(0.454)	(0.289)	(0.451)	(0.311)	(0.163)	(<.001)
HHINDEX	–0.05	–0.08	0.04	0.04	0.15	0.02	0.07	–0.06	–0.02	–0.09	–0.08	0.05	0.01
	(0.013)	(<.001)	(0.040)	(0.038)	(<.001)	(0.192)	(<.001)	(<.001)	(0.184)	(<.001)	(<.001)	(0.002)	(0.724)
OWNERSHIP	0.09	0.08	0.02	–0.07	–0.14	–0.04	–0.10	0.09	0.03	0.03	0.08	–0.12	–0.08
	(<.001)	(<.001)	(0.492)	(<.001)	(<.001)	(0.044)	(<.001)	(<.001)	(0.091)	(0.140)	(<.001)	(<.001)	(<.001)

(Continued)

Table 3—Continued

	CASH	REGULATE	COMPLETE	RUNUP	MTB	ROA	GROWTH	LIQUIDIN.	ASIZE	RSIZE	POISONPILL	HHINDEX
REGULATE	–0.18 (<.001)											
COMPLETE	0.01 (0.376)	0.05 (0.004)										
RUNUP	0.05 (0.002)	–0.04 (0.024)	0.07 (<.001)									
MTB	–0.05 (0.007)	–0.18 (<.001)	0.01 (0.701)	–0.01 (0.464)								
ROA	0.01 (0.522)	0.06 (<.001)	–0.05 (0.040)	0.02 (0.185)	–0.22 (<.001)							
GROWTH	–0.08 (<.001)	–0.12 (<.001)	–0.04 (0.030)	–0.01 (0.457)	0.18 (<.001)	–0.004 (0.818)						
LIQUIDINDEX	0.06 (0.002)	–0.38 (<.001)	–0.05 (0.022)	–0.06 (0.002)	0.22 (<.001)	–0.04 (0.028)	0.17 (<.001)					
ASIZE	0.13 (<.001)	–0.11 (<.001)	0.08 (<.001)	0.02 (0.329)	0.06 (0.003)	0.01 (0.623)	0.08 (<.001)	0.20 (<.001)				
RSIZE	–0.14 (<.001)	0.01 (0.742)	–0.21 (<.001)	–0.14 (<.001)	0.02 (0.346)	0.08 (<.001)	–0.04 (0.047)	0.14 (<.001)	–0.35 (<.001)			
POISONPILL	–0.10 (<.001)	–0.01 (0.565)	0.04 (0.068)	0.06 (0.008)	0.05 (0.013)	–0.05 (0.025)	0.04 (0.080)	0.03 (0.156)	0.06 (0.024)	–0.07 (0.004)		
HHINDEX	–0.05 (0.004)	0.12 (<.001)	–0.004 (0.818)	0.03 (0.090)	–0.02 (0.293)	–0.06 (0.001)	0.05 (0.004)	–0.34 (<.001)	–0.07 (0.001)	–0.24 (<.001)	–0.01 (0.733)	
OWNERSHIP	0.16 (<.001)	–0.19 (<.001)	–0.03 (0.079)	–0.05 (0.006)	0.04 (0.022)	0.05 (0.005)	–0.07 (<.001)	0.41 (<.001)	0.12 (<.001)	0.21 (<.001)	–0.01 (0.529)	–0.42 (<.001)

Table 4
Bid Premium and Valuation Multiple Sorted by Information Uncertainty

This table shows the average and median (in parentheses) bid premium and valuation multiple OV/EBITDA of five groups sorted by the target's level of information uncertainty as measured by analyst forecast DISPERSION and forecast ERROR for 2,676 mergers and acquisitions announced between 1986 and 2015. The definitions of the variables are provided in Appendix A.

	Premium	OV/EBITDA
Panel A: Sorted by DISPERSION		
Q1 [Low]	0.354	12.9
	(0.321)	(10.8)
Q2	0.371	11.5
	(0.316)	(9.58)
Q3	0.359	9.04
	(0.326)	(8.33)
Q4	0.386	7.83
	(0.357)	(6.36)
Q5 [High]	0.391	5.97
	(0.376)	(4.47)
Difference	0.048 [a]	<.001
[Q1-Q5]	0.043 [b]	<.001
Panel B: Sorted by ERROR		
Q1 [Low]	0.382	12.7
	(0.329)	(10.5)
Q2	0.362	11.8
	(0.298)	(9.78)
Q3	0.345	9.26
	(0.315)	(8.61)
Q4	0.438	7.29
	(0.389)	(6.42)
Q5 [High]	0.428	5.46
	(0.362)	(4.36)
Difference	0.037	<.001
[Q1-Q5]	0.023	<.001

[a]: *p*-value of the t-test for the average value between Q1 and Q5.
[b]: *p*-value of two-tailed Wilcoxon test for the median value between Q1 and Q5.

Table 5
Regressions of Bid Premium and Valuation Multiple on Information Uncertainty

This table presents the regression results of bid premium and valuation multiple OV/EBITDA on the target's level of information uncertainty as measured by analyst forecast DISPERSION and forecast ERROR for 2,676 mergers and acquisitions announced between 1986 and 2015. The definitions of the variables are provided in Appendix A. Significance is based on White-adjusted standard errors with *p*-values reported in parentheses. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
	Premium	OV/EBITDA	Premium	OV/EBITDA
Intercept	0.63***	5.6*	0.83***	2.87
	(<.001)	(0.055)	(<.001)	(0.773)
DISPERSION	3.25*	–37.2***		
	(0.066)	(<.001)		
ERROR			0.26**	–24.8***
			(0.042)	(<.001)
DIVERSIFY	–0.02*	0.46	–0.03	0.52
	(0.074)	(0.709)	(0.165)	(0.746)
TOEHOLD	–0.0002*	–0.06**	–0.0001*	–0.05**
	(0.096)	(0.029)	(0.085)	(0.046)
TENDER	0.12***	–1.21	0.10***	–0.56
	(<.001)	(0.438)	(<.001)	(0.781)
COMPETE	0.03**	5.04**	0.044	4.59*
	(0.032)	(0.021)	(0.106)	(0.087)
TLISTED	–0.01	–3.19**	–0.01	–3.01
	(0.630)	(0.043)	(0.817)	(0.142)
HOSTILE	–0.033	–3.12*	–0.04	–4.89**
	(0.306)	(0.092)	(0.165)	(0.049)
PENNY	–0.05	–7.04	0.10	–1.04
	(0.490)	(0.110)	(0.146)	(0.845)
POOLING	0.01*	7.28***	0.02**	9.36***
	(0.077)	(<.001)	(0.020)	(<.001)
CASH	0.03**	3.45	0.02**	3.82
	(0.014)	(0.207)	(0.035)	(0.430)
REGULATE	–0.12***	–3.14	–0.08***	–0.12
	(<.001)	(0.564)	(0.005)	(0.953)
COMPLETE	0.05	0.796	0.001	–2.84
	(0.125)	(0.673)	(0.983)	(0.223)
RUNUP	0.35***	0.958	0.48***	0.951
	(<.001)	(0.744)	(<.001)	(0.785)
MTB	–0.008***	0.04**	–0.01***	0.18**
	(0.006)	(0.048)	(0.002)	(0.022)
ROA	-0.001	0.79**	0.002	0.48*
	(0.864)	(0.015)	(0.578)	(0.068)
GROWTH	–0.001	2.18***	0.009	1.86*
	(0.956)	(0.002)	(0.489)	(0.069)
LIQUIDINDEX	0.017*	–3.00**	0.021**	–3.12**
	(0.057)	(0.048)	(0.033)	(0.034)

RSIZE	–0.264***	3.69	–0.44***	6.28
	(0.008)	(0.116)	(<.001)	(0.197)
ASIZE	0.02**	–0.31*	0.03***	–0.52**
	(0.027)	(0.054)	(<.001)	(0.043)
POISONPILL	0.05	2.36	0.06	1.87
	(0.203)	(0.226)	(0.146)	(0.275)
HHINDEX	0.032	–10.04*	0.08	–6.23
	(0.749)	(0.084)	(0.328)	(0.331)
OWNERSHIP	0.01**	6.06**	0.05**	9.33**
	(0.047)	(0.038)	(0.031)	(0.016)
Year Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes
Observation	2,334	2,334	2,513	2,513
Adj R^2	0.207	0.156	0.216	0.153

Table 6
Acquirer Abnormal Return Sorted by Target Information Uncertainty and Valuation Multiple

This table reports the average and median (in parentheses) acquirer cumulative abnormal return (ACAR) sorted into five groups by analyst forecast DISPERSION, forecast ERROR, and valuation multiple OV/EBITDA for 2,676 mergers and acquisitions announced between 1986 and 2015. Cash offer includes bids conducted with a pure cash offer. Non-cash offer include bids conducted with either a pure equity offer or a mixed offer of cash and equity. The definitions of the variables are provided in Appendix A. *, **, and *** indicate that the average value is significantly different from 0 at the 10%, 5%, and 1% levels, respectively.

	Whole Sample	Cash Offer	Non-Cash Offer
Panel A: Sorted by DISPERSION			
Q1 [Low]	–0.016***	0.001	–0.030***
	(–0.008)	(–0.004)	(–0.027)
Q2	–0.014***	0.002	–0.028***
	(–0.006)	(–0.002)	(–0.016)
Q3	–0.010**	0.004	–0.024***
	(–0.005)	(0.003)	(–0.015)
Q4	–0.009**	0.005	–0.016***
	(–0.005)	(0.002)	(–0.012)
Q5 [High]	–0.001	0.006*	–0.005
	(0.0004)	(0.005)	(–0.005)
Difference	0.011 [a]	0.064	0.007
[Q1-Q5]	0.025 [b]	0.053	0.021
Panel B: Sorted by ERROR			
Q1 [Low]	–0.016***	–0.002	–0.022***
	(–0.006)	(–0.003)	(–0.024)
Q2	–0.015***	0.0003	–0.021***
	(–0.006)	(–0.001)	(–0.014)
Q3	–0.008**	0.007*	–0.009**
	(–0.005)	(–0.0003)	(–0.013)
Q4	–0.004*	0.006*	–0.010**
	(–0.004)	(0.004)	(–0.011)
Q5 [High]	0.0006	0.009**	–0.007*
	(0.0001)	(0.007)	(–0.005)
Difference	0.008	0.037	0.002
[Q1-Q5]	0.028	0.046	0.013
Panel C: Sorted by OV/EBITDA			
Q1 [Low]	0.002	0.014***	–0.003
	(–0.001)	(0.005)	(–0.007)
Q2	-0.001	0.006	–0.011**
	(–0.003)	(0.004)	(–0.007)
Q3	–0.009**	0.005	–0.021***

	(–0.006)	(0.003)	(–0.014)
Q4	–0.012***	–0.002	–0.024***
	(–0.008)	(–0.002)	(–0.015)
Q5 [High]	–0.021***	–0.007*	–0.030***
	(–0.012)	(–0.006)	(–0.024)
Difference	0.002	0.005	0.019
[Q1-Q5]	0.023	0.016	0.028

[a]: *p*-value of the t-test between Q1 and Q5.
[b]: *p*-value of two-tailed Wilcoxon test between Q1 and Q5.

Table 7
Regressions of Acquirer Cumulative Abnormal Return on Valuation Multiple and Target Information Uncertainty

This table presents the regression results of acquirer cumulative abnormal return (ACAR) on valuation multiple OV/EBITDA and target's level of information uncertainty measured by analyst forecast DISPERSION and forecast ERROR for 2,676 mergers and acquisitions announced between 1986 and 2015. AROA is the ratio of the acquirer's net income to total assets at the end of the year prior to the takeover announcement. AGROWTH is the acquirer's proportional change in sales in the year before the takeover announcement. AMTB is the ratio of the market value of the acquirer's common stock to the book value of equity at the end of the year before the takeover announcement. Other variable definitions are provided in Appendix A. Significance is based on White-adjusted standard errors with *p*-values reported in parentheses. *, **, and *** denote the significance levels of 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)
Intercept	0.07***	0.06*	0.06**	0.05*	0.06**
	(0.005)	(0.070)	(0.027)	(0.085)	(0.030)
OV/EBITDA/100	–0.013**			–0.019**	–0.011**
	(0.018)			(0.045)	(0.037)
DISPERSION		0.02*		0.01	
		(0.075)		(0.123)	
ERROR			0.15*		0.14*
			(0.060)		(0.080)
DIVERSIFY	–0.01**	–0.012**	–0.01**	–0.01**	–0.01**
	(0.032)	(0.036)	(0.037)	(0.038)	(0.039)
Premium	–0.02**	–0.02**	–0.02**	–0.02**	–0.02**
	(0.016)	(0.041)	(0.014)	(0.043)	(0.014)
TOEHOLD/100	0.01*	0.02*	0.01	0.01*	0.01*
	(0.056)	(0.098)	(0.112)	(0.052)	(0.078)
TENDER	0.006	0.002	0.006	0.002	0.006
	(0.344)	(0.739)	(0.344)	(0.792)	(0.350)
COMPETE	–0.003	–0.003	–0.003	–0.002	–0.002
	(0.717)	(0.780)	(0.713)	(0.820)	(0.737)
TLISTED	–0.001	–0.003	–0.001	–0.004	–0.001
	(0.885)	(0.664)	(0.854)	(0.623)	(0.833)
HOSTILE	0.003	0.005	0.004	0.003	0.003
	(0.722)	(0.591)	(0.601)	(0.691)	(0.673)
PENNY	0.03*	0.04*	0.03	0.04*	0.03
	(0.064)	(0.051)	(0.102)	(0.057)	(0.105)
POOLING	–0.006	–0.005	–0.006	–0.003	–0.004
	(0.405)	(0.535)	(0.382)	(0.670)	(0.472)
CASH	0.02***	0.02***	0.02***	0.02***	0.02***
	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)
REGULATE	0.0003	0.003	0.001	0.002	0.001
	(0.960)	(0.759)	(0.862)	(0.764)	(0.856)
COMPLETE	–0.005	0.001	–0.004	0.0002	-0.005
	(0.438)	(0.928)	(0.489)	(0.979)	(0.463)
LIQUIDINDEX	–0.02***	–0.02***	–0.02***	–0.02***	–0.02***

	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)
RSIZE	–0.04**	–0.04*	–0.03	–0.04	–0.03
	(0.048)	(0.081)	(0.120)	(0.116)	(0.146)
ASIZE	–0.0001	0.001	0.0005	0.002	0.001
	(0.964)	(0.515)	(0.785)	(0.433)	(0.740)
AROA	–0.0003	–0.002	–0.0001	–0.002	–0.0002
	(0.901)	(0.477)	(0.965)	(0.506)	(0.942)
AGROWTH	–0.0003	–0.001	–0.0003	–0.001	–0.0003
	(0.876)	(0.621)	(0.868)	(0.639)	(0.880)
AMTB	–0.0003	–0.0004*	–0.0003	–0.0004*	–0.0003
	(0.108)	(0.087)	(0.161)	(0.073)	(0.128)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes
Observation	2,676	2,334	2,513	2,334	2,513
Adj R^2	0.069	0.080	0.071	0.083	0.073

Table 8
Regressions of Bid Premium and Valuation Multiple on Information Uncertainty by Acquirer CEO Overconfidence

Panel A presents the average and median (in parentheses) bid premium and valuation multiple sorted by the target's level of information uncertainty for 1,079 mergers and acquisitions announced between 1986 and 2015. The bid premium and valuation multiple are compared among themselves between quintile Q1 and quintile Q5, with *p*-values reported at the bottom of the panel. The sample is divided into two groups based on acquirer CEO overconfidence measured by Overconfidence1 and Overconfidence2. Panel B presents the regression results of bid premium and valuation multiple on the target's information uncertainty level and acquirer CEO overconfidence. Overconfidence1 is a dummy variable that equals 1 if an acquirer CEO holds options at 100% or greater moneyness and 0 otherwise. Overconfidence2 is a dummy variable that equals 1 if an acquirer CEO's net share purchase is positive throughout her entire tenure at the firm and 0 otherwise. The definitions of other variables are provided in Appendix A. Significance is based on White-adjusted standard errors, with *p*-values reported in parentheses. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively.

Panel A: Bid premium and valuation multiple sorted by information uncertainty and CEO overconfidence

	Bid Premium				Valuation Multiple			
	Overconfidence1		Overconfidence2		Overconfidence1		Overconfidence2	
	1 (N=258)	0 (N=565)	1 (N=305)	0 (N=774)	1 (N=258)	0 (N=565)	1 (N=305)	0 (N=774)
Sorted by DISPERSION								
Q1 [Low]	0.318	0.364	0.321	0.402	15.7	19.1	17.6	15.1
	(0.27)	(0.35)	(0.30)	(0.33)	(14.70)	(15.30)	(13.80)	(14.60)
Q2	0.339	0.385	0.367	0.403	13.9	16.5	15.2	15.5
	(0.28)	(0.35)	(0.33)	(0.35)	(12.60)	(13.20)	(12.10)	(12.90)
Q3	0.378	0.402	0.388	0.427	10.6	12.9	14.8	13.5
	(0.29)	(0.36)	(0.36)	(0.36)	(9.50)	(10.50)	(10.00)	(9.23)
Q4	0.405	0.412	0.389	0.435	8.91	8.05	8.01	7.94
	(0.32)	(0.36)	(0.39)	(0.38)	(7.95)	(7.32)	(7.61)	(6.50)
Q5 [High]	0.453	0.438	0.417	0.448	7.63	6.59	7.49	6.85
	(0.41)	(0.39)	(0.46)	(0.37)	(7.42)	(7.14)	(7.26)	(5.29)
Difference	<.001	0.055	0.026	0.067	0.034	0.014	0.007	0.004
[Q1-Q5]	<.001	0.046	<.001	0.048	0.021	<.001	0.032	<.001
Sorted by ERROR								

Q1 [Low]	0.271	0.361	0.314	0.317	15	22.7	17.4	14.3
	(0.30)	(0.33)	(0.27)	(0.28)	(13.20)	(14.20)	(12.50)	(13.10)
Q2	0.347	0.384	0.327	0.357	13.1	15.6	10.5	11.9
	(0.30)	(0.35)	(0.29)	(0.32)	(9.90)	(10.60)	(11.20)	(11.30)
Q3	0.379	0.404	0.362	0.389	14.3	9.34	10	9.9
	(0.32)	(0.37)	(0.34)	(0.36)	(10.90)	(8.72)	(9.90)	(10.10)
Q4	0.399	0.43	0.415	0.421	9.82	9.27	9.21	9.18
	(0.33)	(0.38)	(0.37)	(0.37)	(8.56)	(8.47)	(8.81)	(8.16)
Q5 [High]	0.486	0.477	0.453	0.451	6.55	5.91	6.13	5.86
	(0.43)	(0.42)	(0.41)	(0.41)	(6.03)	(5.29)	(5.31)	(6.28)
Difference	<.001	0.005	0.002	0.019	<.001	<.001	<.001	0.011
[Q1-Q5]	0.006	0.037	0.004	0.027	0.016	<.001	<.001	<.001

Panel B: Regressing bid premium and valuation multiple on information uncertainty and CEO overconfidence

	Bid Premium				Valuation Multiple			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.69***	0.56**	0.73***	0.71***	19.2	30.8	14.9	21
	(0.001)	(0.016)	(<.001)	(<.001)	(0.412)	(0.218)	(0.466)	(0.338)
DISPERSION	2.65**	3.07*			–43**	–49**		
	(0.015)	(0.078)			(0.022)	(0.048)		
ERROR			0.29*	0.24*			–51***	–53**
			(0.061)	(0.059)			(0.002)	(0.028)
Overconfidence1	0.007		–0.05		–13.2		–5.41	
	(0.879)		(0.238)		(0.358)		(0.211)	
Overconfidence2		–0.03		–0.07**		–3.91		–1.13
		(0.491)		(0.045)		(0.372)		(0.755)
Overconfidence1*DISPERSION	0.52**				29***			
	(0.049)				(<.001)			
Overconfidence2*DISPERSION		0.08*				23**		
		(0.081)				(0.018)		
Overconfidence1*ERROR			0.73				37*	
			(0.168)				(0.089)	
Overconfidence2*ERROR				0.06				34*
				(0.248)				(0.051)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	758	991	823	1,079	758	991	823	1,079
Adj R^2	0.246	0.254	0.212	0.231	0.198	0.189	0.186	0.177

Table 9
Endogeneity Tests Using Unsuccessful Bid Samples

The table reports regression results on 107 targets not successfully acquired in the initial bids but successfully acquired in the subsequent bids announced between 1986 and 2015. Panel A presents the regression results of valuation multiple OV/EBITDA on the target's information uncertainty level measured by analyst forecast DISPERSION and forecast ERROR. Panel B presents the regression results of changes in valuation multiple (ΔOV/EBITDA) on changes in target's information uncertainty (ΔDISPERSION, ΔERROR). The definitions of the variables are provided in Appendix A. Significance is based on White-adjusted standard errors with *p*-values reported in parentheses. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively.

Panel A: Firm fixed effects panel regression		
	(1)	(2)
Intercept	4.32**	0.22
	(0.018)	(0.980)
DISPERSION	–34**	
	(0.015)	
ERROR		–21**
		(0.028)
Control Variables	Yes	Yes
Firm Fixed Effects	Yes	Yes
Year Dummies	Yes	Yes
Industry Dummies	Yes	Yes
Observation	188	214
Adj R^2	0.349	0.301
Panel B: Regression on changes		
	(1)	(2)
Intercept	–15.4	–0.61
	(0.623)	(0.862)
ΔDISPERSION	–15*	
	(0.095)	
ΔERROR		–28**
		(0.038)
Control Variables	Yes	Yes
Year Dummies	Yes	Yes
Industry Dummies	Yes	Yes
Observation	94	107
Adj R^2	0.276	0.256

Table 10
Alternative Measures of Information Uncertainty

Panel A shows the average and median (in parentheses) valuation multiple of five groups sorted by the target's level of information uncertainty for 2,676 mergers and acquisitions announced between 1986 and 2015. The valuation multiples are compared between quintile Q1 and quintile Q5, with *p*-values reported at the bottom of the panel. Panel B reports the regression results of valuation multiple on information uncertainty. Valuation multiple is obtained as OV/EBITDA. Information uncertainty is measured with bid-ask spread (SPREAD) and idiosyncratic volatility (VOLATILITY). The definitions of the variables are provided in Appendix A. Significance is based on White-adjusted standard errors, with *p*-values reported in parentheses. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively.

Panel A. Valuation multiple sorted by target information uncertainty level		
	SPREAD	VOLATILITY
Q1 [Low]	14.1	12.5
	(10.9)	(11.2)
Q2	12.5	8.56
	(9.14)	(9.21)
Q3	8.96	9.11
	(8.06)	(8.13)
Q4	8.37	7.21
	(8.01)	(5.23)
Q5 [High]	7.21	5.92
	(5.91)	(3.37)
Difference	<0.001	<0.001
[Q1-Q5]	<0.001	<0.001
Panel B. Regressing valuation multiple on target information uncertainty level		
	(1)	(2)
Intercept	8.13	18.4**
	(0.560)	(0.049)
SPREAD	–24*	
	(0.065)	
VOLATILITY*100		–2.85***
		(<.001)
Control Variables	Yes	Yes
Year Dummies	Yes	Yes
Industry Dummies	Yes	Yes
Observation	2,676	2,676
Adj R^2	0.157	0.163

Table 11
Alternative Measures of Valuation Multiple

Panel A shows the average and median (in parentheses) valuation multiple of five groups sorted by target information uncertainty for 2,676 mergers and acquisitions announced between 1986 and 2015. The valuation multiples are compared between quintile Q1 and quintile Q5, with *p*-values reported at the bottom of the panel. Panel B reports the regression results of valuation multiple on information uncertainty. Valuation multiple is calculated as the industry-adjusted price-to-earnings ratio (OV/EBITDA_adj.), the offer value relative to the target's enterprise value (Offer/EV), the offer value relative to the book value of the target's equity (Offer/BV), or the offer value relative to the target's sales (Offer/Sale). Information uncertainty is measured with analyst forecast DISPERSION or forecast ERROR. The definitions of the variables are provided in Appendix A. Significance is based on White-adjusted standard errors, with *p*-values reported in parentheses. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively.

Panel A. Valuation multiple sorted by target information uncertainty level								
	Sorted by DISPERSION				Sorted by ERROR			
	OV/EBITDA_adj.	Offer/EV	Offer/BV	Offer/Sale	OV/EBITDA_adj.	Offer/EV	Offer/BV	Offer/Sale
Q1 [Low]	6.16	1.18	4.04	2.69	5.01	1.19	3.88	3.10
	(3.50)	(1.12)	(3.04)	(2.05)	(3.31)	(1.03)	(3.07)	(2.08)
Q2	5.11	1.11	4.02	2.26	4.58	1.07	3.61	3.05
	(3.31)	(1.07)	(2.46)	(1.73)	(2.74)	(0.96)	(2.73)	(1.94)
Q3	3.61	1.05	3.57	2.40	4.10	1.02	3.12	2.90
	(2.32)	(0.93)	(2.35)	(1.51)	(2.54)	(0.92)	(2.47)	(1.66)
Q4	3.47	0.99	3.56	2.18	2.78	1.02	3.01	2.76
	(1.80)	(0.92)	(2.31)	(1.23)	(2.08)	(0.91)	(2.35)	(1.54)
Q5 [High]	2.92	0.92	2.81	2.02	2.21	0.85	2.53	2.44
	(1.46)	(0.84)	(2.13)	(1.18)	(1.41)	(0.83)	(2.16)	(1.09)
Difference	<.001	<.001	<.001	<.001	<.001	0.027	0.032	0.013
[Q1-Q5]	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001

Panel B. Regressing valuation multiple on target information uncertainty level								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OV/EBITDA_adj.	Offer/EV	Offer/BV	Offer/Sale	OV/EBITDA_adj.	Offer/EV	Offer/BV	Offer/Sale
Intercept	–22**	1.83***	2.44	–0.82	–16.9**	1.72***	110**	–5.65***
	(0.038)	(<.001)	(0.476)	(0.502)	(0.028)	(<.001)	(0.013)	(0.005)

DISPERSION	–3.8***	–0.59***	–15***	–0.55*				
	(0.009)	(0.010)	(0.003)	(0.057)				
ERROR					–37***	–1.01**	–35*	–7.57**
					(0.005)	(0.028)	(0.051)	(0.027)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	2,201	2,334	2,334	2,334	2,381	2,513	2,513	2,513
Adj R^2	0.066	0.126	0.095	0.181	0.063	0.165	0.086	0.176

Table 12
Robustness Tests on Valuation Multiple

Panel A shows the average and median (in parentheses) valuation multiple of five groups sorted by the target's level of information uncertainty for 2,676 mergers and acquisitions announced between 1986 and 2015. The valuation multiples are compared between quintile Q1 and quintile Q5, with *p*-values reported at the bottom of the panel. Panel B reports the regression results of valuation multiple on information uncertainty. The coefficients of control variables are not reported. Valuation multiple is obtained as OV/EBITDA. Information uncertainty is measured with analyst forecast DISPERSION. The definitions of the variables are provided in Appendix A. Significance is based on White-adjusted standard errors, with *p*-values reported in parentheses. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively.

	(1) Hostile bids	(2) Friendly bids	(3) All-cash offer	(4) All-stock offer	(5) Diversifying bids	(6) Non-diver. bids	(7) Tender offer	(8) Non-tender offer	(9) Completed Bids	(10) No exceptional cases	(11) Analysts ≥4
Panel A. Valuation multiple sorting											
Q1 [Low]	9.87	14.3	12.1	16.1	13.1	12.6	12.3	13.7	14.4	14.3	13.1
	(8.88)	(11.3)	(10.1)	(11.6)	(10.1)	(11.1)	(11.5)	(10.2)	(11.3)	(10.4)	(10.6)
Q2	8.18	12.7	11.6	17.1	11.2	13.1	11.1	12.2	12.7	12.5	12.9
	(7.52)	(10.3)	(9.86)	(10.4)	(9.50)	(10.5)	(10.1)	(9.56)	(10.2)	(9.94)	(10.1)
Q3	8.34	10.2	11.8	10.5	9.06	9.01	11.7	8.85	10.4	11.4	10.5
	(8.12)	(9.12)	(9.55)	(8.70)	(8.16)	(9.89)	(9.29)	(8.10)	(9.10)	(9.29)	(9.58)
Q4	6.67	8.13	6.87	5.57	8.36	7.26	7.97	6.83	8.13	8.02	8.36
	(6.02)	(6.91)	(7.79)	(6.06)	(7.05)	(6.16)	(8.24)	(6.10)	(6.81)	(7.49)	(7.83)
Q5 [High]	4.57	6.18	5.25	4.28	6.59	5.21	6.68	4.26	5.53	5.43	5.69
	(3.09)	(4.99)	(4.65)	(3.49)	(4.88)	(4.32)	(5.43)	(3.09)	(4.32)	(4.70)	(5.21)
Difference	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
[Q1-Q5]	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Panel B. Regressing valuation multiple											
DISPERSION	–32*	–39***	–28***	–41***	–26***	–39**	–27**	–42***	–43***	–45***	–44***
	(0.073)	(<.001)	(0.008)	(0.004)	(0.007)	(0.026)	(0.018)	(0.006)	(<.001)	(0.003)	(0.002)
Year Dum.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind. Dum.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	356	1,978	768	1,065	1,708	626	414	1,920	2,045	1,486	1,517
Adj R^2	0.276	0.163	0.189	0.176	0.181	0.241	0.193	0.174	0.158	0.167	0.171

Table 13
Robustness Tests on Acquirer Cumulative Abnormal Return Regressions

This table presents the robustness tests on the regression of acquirer cumulative abnormal return (ACAR) on valuation multiple OV/EBITDA and information uncertainty level as measured by analyst forecast DISPERSION and forecast ERROR for 2,676 mergers and acquisitions announced between 1986 and 2015. Panel A reports the regression results for the completed takeover sample. Panel B reports the regression result for the completed takeover sample with the acquirer firm size (ASIZE) larger than the median value. Panel C reports the regression results for the whole sample by payment method. Panel D reports the regression results for the whole sample by acquisition form. The coefficients of control variables are not reported. The definitions of the variables are provided in Appendix A. Significance is based on White-adjusted standard errors, with *p*-values reported in parentheses. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)
Panel A: Completed takeover sample					
OV/EBITDA/100	–0.015**			–0.017**	–0.016**
	(0.037)			(0.043)	(0.032)
DISPERSION		0.03*		0.02*	
		(0.053)		(0.096)	
ERROR			0.17**		0.19
			(0.046)		(0.135)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Ind. Dummies	Yes	Yes	Yes	Yes	Yes
Observation	2,375	2,045	2,206	2,045	2,206
Adj R^2	0.071	0.081	0.073	0.085	0.075
Panel B: Completed takeover sample, acquirer size is larger than the median					
OV/EBITDA/100	–0.025**			–0.030**	–0.027**
	(0.019)			(0.024)	(0.026)
DISPERSION		0.12*		0.14*	
		(0.063)		(0.088)	
ERROR			0.25		0.26
			(0.147)		(0.173)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Ind. Dummies	Yes	Yes	Yes	Yes	Yes
Observation	1,186	1,022	1,103	1,022	1,103
Adj R^2	0.083	0.095	0.086	0.098	0.088
Panel C: Whole sample, pure cash offer					
OV/EBITDA/100	–0.016**			–0.015*	–0.016*
	(0.021)			(0.087)	(0.075)
DISPERSION		0.038*		0.024	
		(0.076)		(0.188)	
ERROR			0.08*		0.03
			(0.083)		(0.139)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Ind. Dummies	Yes	Yes	Yes	Yes	Yes
Observation	894	768	832	768	832
Adj R^2	0.085	0.094	0.087	0.097	0.090
Whole sample, pure stock offer					

OV/EBITDA/100	–0.019**			–0.028*	–0.018*
	(0.035)			(0.055)	(0.067)
DISPERSION		0.031*		0.028	
		(0.054)		(0.132)	
ERROR			0.29**		0.27**
			(0.035)		(0.041)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Ind. Dummies	Yes	Yes	Yes	Yes	Yes
Observation	1,237	1,065	1,123	1,065	1,123
Adj R^2	0.083	0.089	0.085	0.093	0.091
Panel D: Whole sample, tender offer					
OV/EBITDA/100	–0.012*			–0.033*	–0.016
	(0.057)			(0.069)	(0.138)
DISPERSION		0.089*		0.084	
		(0.092)		(0.150)	
ERROR			0.26*		0.25*
			(0.075)		(0.094)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Ind. Dummies	Yes	Yes	Yes	Yes	Yes
Observation	481	414	425	414	425
Adj R^2	0.117	0.119	0.121	0.121	0.123
Whole sample, non-tender offer					
OV/EBITDA/100	–0.019***			–0.022**	–0.019**
	(0.009)			(0.011)	(0.014)
DISPERSION		0.021**		0.016	
		(0.038)		(0.152)	
ERROR			0.15**		0.14**
			(0.025)		(0.035)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Ind. Dummies	Yes	Yes	Yes	Yes	Yes
Observation	2,195	1,920	2,088	1,920	2,088
Adj R^2	0.076	0.087	0.079	0.091	0.083

Appendix A
Definitions of Variables

This table defines the variables used in this study, which contains 2,676 mergers and acquisitions announced between 1986 and 2015.

Variable	Definition
Premium	The premium of the offer price relative to the target's stock price four weeks prior to the takeover announcement.
OV/EBITDA	The ratio of the offer value to the product of the percentage of target outstanding shares acquired in the transaction and the target's earnings before interest, taxes, and depreciation and amortization of intangibles (EBITDA) at the end of the year immediately before the bid announcement.
DISPERSION	The standard deviation of analysts' earnings forecasts made in the event window [-126, -64] on the target's one-year-ahead earnings, scaled by the target's stock price on trading day –64, where day 0 is the takeover announcement day.
ERROR	The ratio of the absolute difference between the forecast earnings and the actual earnings per share in the last month of the fiscal year before the takeover announcement to the price per share at the beginning of the month.
ACAR	Acquirer cumulative abnormal return over the event window [-1, +1], where day 0 is the bid announcement day. Abnormal return is defined as the market model residual, where the parameters are estimated over the [-205, -6] event window relative to the announcement day.
DIVERSIFY	Equals 1 if the primary business line of the acquirer is different with that of the target and 0 otherwise.
TOEHOLD	The percentage of target shares held by the acquirer prior to the takeover announcement.
TENDER	Equals 1 if the takeover is advanced via tender offer and 0 otherwise.
COMPETE	The number of bidders in a takeover.
HOSTILE	Equals 1 if the offer is resisted by the target and 0 otherwise.
POISONPILL	Equals 1 if the target adopts a poison pill or shareholder rights plan before the takeover announcement and 0 otherwise.
COMPLETE	Equals 1 if a takeover transaction is successfully consummated and 0 otherwise.
POOLING	Equals 1 if the pooling-of-interest accounting method is reported in takeovers and 0 if the purchase method is used.
CASH	Equals 1 for a pure cash offer and 0 for a pure stock offer or a mixed offer of stock and cash.
TLISTED	Equals 1 if the target is listed on the NYSE or Amex prior to the takeover announcement and 0 otherwise.
PENNY	Equals 1 if the target's stock price is below $1 six weeks prior to bid announcement and 0 otherwise.
RUNUP	Target's average cumulative abnormal return over the period [-41, -1] using a value-weighted market model estimated over the [-205, -6] event window, where day 0 is the bid announcement day.

LIQUIDINDEX	Target's stock liquidity index constructed with volume, turnover, the bid-ask spread, and the liquidity ratio Amihud (based on Amihud (2002)). Volume is defined as the logarithm of the average daily number of shares traded over the [-205, -42] event window, where day 0 is the bid announcement day. Turnover is defined as the logarithm of volume standardized by the number of shares outstanding. The bid-ask spread is obtained as the daily relative bid-ask spread averaged over the [-205, -42] event window, where the daily relative spread is the ratio of the absolute value of the bid-ask spread over the midpoint of the spread. The liquidity ratio Amihud is the aggregate ratio of daily absolute return to daily dollar trading volume over the [-205, -42] event window.
MTB	The ratio of the market value of the target's common equity to the book value of equity at the end of the year before the takeover announcement.
ROA	The ratio of the target's net income to total assets at the end of the year prior to the takeover announcement.
GROWTH	The target's proportional change in sales in the year before the takeover announcement.
REGULATE	Equals 1 if the target belongs to financial, real estate, and trade industries and 0 otherwise.
RSIZE	The ratio of the market value of the target's common equity to that of the acquirer at the end of the year before the takeover announcement.
ASIZE	The logarithm of the acquirer's market value of common equity at the end of the fiscal year before the takeover announcement.
OWNERSHIP	The number of institutional blockholders owning more than 5% of the target's shares at the end of the year prior to the takeover announcement.
HHINDEX	Herfindahl-Hirschman index obtained by ownership concentration.
Overconfidence1	Equals 1 if an acquirer CEO holds options at 100% or greater moneyness and 0 otherwise.
Overconfidence2	Equals 1 if an acquirer CEO's net share purchase is positive throughout her entire tenure at the firm and 0 otherwise.
ΔOV/EBITDA	Change of valuation multiple obtained as a target's OV/EBITDA received in a bid, deducting the target's OV/EBITDA received in a previous unsuccessful bid.
ΔDISPERSION	Change of information uncertainty level obtained as a target's analyst forecast DISPERSION in a bid, deducting the target's analyst forecast DISPERSION in a previous unsuccessful bid.
ΔERROR	Change of information uncertainty level obtained as a target's analyst forecast ERROR in a bid, deducting the target's analyst forecast ERROR in a previous unsuccessful bid.
SPREAD	The daily relative bid-ask spread averaged over the fiscal year before the announcement of the takeover, where the daily relative spread is the ratio of the absolute value of the bid-ask spread over the midpoint of the spread.
VOLATILITY	The standard deviation of the target's daily abnormal stock return from 365 days until 63 days prior to the takeover announcement date.

Offer/EV	The offer value in a deal normalized by the product of the percentage of the target's outstanding shares acquired in the transaction and the enterprise value of a target at the end of the year immediately before the bid announcement, where enterprise value is obtained as the market value of equity, plus the book value of debt, minus the book value of cash and cash equivalent.
Offer/BV	The offer value in a deal normalized by the product of the percentage of target outstanding shares acquired in the transaction and the book value of the target's equity at the end of the year immediately before the bid announcement.
Offer/Sale	The offer value in a deal normalized by the product of the percentage of the target's outstanding shares acquired in the transaction and the target's sales at the end of the year immediately before the bid announcement.
OV/EBITDA_adj.	The industry-adjusted price-to-earnings ratio calculated as OV/EBITDA (as defined above) deducting $\widehat{M}$/EBITDA. $\widehat{M}$ is the fitted value of total equity for a takeover target in the year prior to takeover announcement obtained from the regression model $Ln(M_{it}) = c_0 + c_1 \ln(B_{it}) + c_2 \ln(EBITDA_{it}^{+}) + c_3 I_{(<0)} \ln(EBITDA_{it}^{+}) + c_4 Lev_{it} + \varepsilon_{it}$, where $Ln(M_{it})$ is the natural logarithm of the market value of equity for firm *i* in year *t*; $\ln(B_{it})$ is the natural logarithm of the book value of equity for firm *i* in year *t*; $\ln(EBITDA_{it}^{+})$ is the natural logarithm of absolute value of earnings before interest, taxes, and depreciation and amortization of intangibles (EBITDA) for firm *i* in year *t*; $I_{(<0)} \ln(EBITDA_{it}^{+})$ is an indicator function for negative EBITDA; and Lev_{it} is the ratio of total debt to total equity for firm *i* in year *t*.

Appendix B
The Construction of Industry-Adjusted Valuation Multiple

The industry-adjusted valuation multiple, OV/EBITDA_adj., is calculated following Rhodes-Kropf et al. (2005). First, for all the firms contained in the Compustat dataset, an annual, cross-sectional regression is performed for each industry over the sample period, using the following model:[22]

$$Ln(M_{it}) = c_0 + c_1 \ln(B_{it}) + c_2 \ln(EBITDA_{it}^{+}) + c_3 I_{(<0)} \ln(EBITDA_{it}^{+}) + c_4 Lev_{it} + \varepsilon_{it} \quad (3)$$

where $Ln(M_{it})$ is the natural logarithm of market value of equity for firm *i* in year *t*; $\ln(B_{it})$ is the natural logarithm of book value of equity for firm *i* in year *t*; $\ln(EBITDA_{it}^{+})$ is the natural logarithm of absolute value of earnings before interest, taxes, and depreciation and amortization of intangibles (EBITDA) for firm *i* in year *t*; $I_{(<0)} \ln(EBITDA_{it}^{+})$ is an indicator function for negative EBITDA; and Lev_{it} is the ratio of total debt to total equity for firm *i* in year *t*. Second, the fitted value of *M* is obtained from regression model (3) for each firm in each year. The fitted value of total equity for a takeover target in the year prior to takeover announcement is recorded as $\widehat{M}$. Therefore, the industry-adjusted valuation ratio, OV/EBITDA_adj., for a takeover target is calculated as OV/EBITDA (as defined before), deducting $\widehat{M}$/EBITDA.

[22] Industries are classified according to the three-digit SIC codes collected from the CRSP dataset. Cooper and Cordeiro (2008) document that using 10 closely comparable firms is as accurate on average as using the entire cross-section of firms in an industry, but using five comparable firms is slightly less accurate. Therefore, an industry is deleted from the regression if fewer than 10 firms are included in an observation year. The results are qualitatively unchanged if industry classification follows Fama and French (1997).