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Behavioral Aspects of Merger Decisions: The Effect of Investors' Purchase Price and Reference Prices

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by

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Abstract

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Keywords: mergers and acquisitions; reference prices; anchoring; shareholders' purchase price: Prospect Theory.

JEL classification: G34, G41

1. Introduction

Mergers are common practices in the growth strategy of business companies, requiring grand and non-trivial business decisions from both bidder- and target-firm management and shareholders.[1] Assuming there exists an economic logic behind a proposed merger (based, for example, on synergies), the question is always what share of the surplus each side of the deal reaps.

The presumed merger surplus and evidenced pre-merger negotiations between the bidder and target (Boone and Mulherin, 2007; Fich, Cai, and Tran, 2011; Ahern and Sosyura, 2014) leave some room for behavioral impacts on merger offer price. For example, if, as predicted by Prospect Theory, target shareholders perceive their stock purchase price as a primary reference price and exhibit loss aversion, they may insist on higher premiums when they are in loss on the eve of a merger offer. Ye (2014) presents some evidence consistent with Prospect Theory using the Institutional Investors weighted Average Purchase Price (IIAPP, henceforth) developed by Frazzini (2006) as an estimate of purchase price.

However, the IIAPP of Frazzini (2006) is a sectorial measure focusing on the relatively rational institutional investors. Thus, IIAPP may misrepresent all-shareholders' purchase price. We develop a measure of all shareholders' average purchase price, based on the Proportional Trading Model commonly used by courts in securities' fraud litigation (Furbush and Smith, 1994). In a sample comprising all U.S. merger offers from 1990 to 2019 in which both bidder and target are public firms, we examine whether our estimated Target Average Purchase Price (TAPP, in short) serves as an important reference price for the following key deal terms and outcomes: the

[1] Note that throughout the paper we prefer the term "bidder" over the more common term "acquirer" because in some of the merger offers that we examine the offer was rejected.

bidder's decision on offer price, the target shareholders' decision on whether to accept the merger offer, and the wealth transfer between the bidder and the target.

We find that when the TAPP exceeds the target's pre-offer stock price, i.e. target shareholders are in loss on average, the bidder adjusts its offer price upwards (to partially compensate target shareholders for their nominal loss), increasing the offer premium ceteris paribus. Most significantly, the pattern of compensation for the target shareholder loss fits the predictions of Prospect Theory and its s-curve utility of gain/loss: small losses are almost fully compensated via an increase in offer premium, yet the marginal compensation diminishes with loss size (i.e., the marginal compensation for relatively large losses is minute).

Further, in all our tests the TAPP dominates the IIAPP and other conceived purchase price estimators in explaining the merger premium.[2] The dominance of all investors purchase price, TAPP, over institutional investors purchase price, IIAPP, illustrates that retail investors are also considered in merger pre-negotiations. We estimate the retail investors' average purchase price and show that it has a significant impact on the offer premium, especially when institutional investor stake in the firm is below median. When we separate between institutional and retail average purchase prices, the institutional price has a higher impact on offer premium, which illustrates that institutional investors play a central role in pre-merger negotiations. However, the formulation using TAPP appears dominant in its explanatory power to the formulation that breaks TAPP into institutional and retail purchase price; thus, in the rest of the study we use TAPP as our purchase price measure.

[2] We construct several other competitors for TAPP, including a simple and a turnover-weighted average of past prices, and estimators based on the existence of a class of "active" short-term investors such as day traders or robots. None of the more primitive or more advanced estimators we attempted reached the explanatory power of TAPP.

Merger offer price may be associated with other reference prices besides the purchasing price. Most relevant, Baker, Pan and Wurgler (2012) showed that a target firm's peak stock price in the 52 weeks preceding a merger offer (52-week high, in short) is an influential reference price in mergers. The offer premium increases with the ratio of the 52-week high to the pre-offer target stock price, and offer-acceptance likelihood jumps when the offer price exceeds the 52-week high. For target firm shareholders, the 52-week high represents a price they could recently sell for. Thus, possibly to mitigate any regret feelings and convince target management and shareholders to accept a merger offer, the bidder adjusts its offer price in accordance with the ratio of the 52-week high to the pre-offer target-stock price.

The emerging question is: Are TAPP and the 52-week high substitutes or complements? We find that the TAPP and the 52-week high are complementary in explaining the merger offer premium. Both TAPP and the 52-week high significantly impact the merger premium in a way consistent with Prospect Theory, and their effects are about equal in their magnitude.

We also find that both the 52 week-high and TAPP manifest only a minute explanatory power in our Probit analysis of the accept/reject decision of target shareholders. In a test sample of 3,432 merger offer proposals, the accept/reject predictions of a Probit model without reference prices are almost identical to those of a Probit model with reference prices. Apparently, reference prices help determine the merger offer premium, yet once this premium is determined, reference prices' residual effect on the offer-acceptance decision is practically negligible. This evidence is novel and it is consistent with the notion that during the pre-bid private negotiations target shareholders' reservation and reference prices are revealed to the bidder, who in turn adjusts the offer price to a point where these prices do not affect or hinder offer acceptance by target shareholders.

The extra premium paid to compensate target shareholders for their actual losses relative to TAPP and perceived losses relative to the 52-week-high, has non-trivial wealth effects. It increases target shareholders gains and hurts the acquirer stock returns. In our sample, the acquirer stock price manifests negative excess returns that are correlated with the extra premium payments to target shareholders. This appears as a warning to acquirers not to over-consider target shareholder reference prices.

Our study offers several contributions. First, we show that the price shareholders originally paid for their shares significantly impacts M&A deal terms and outcomes. The purchasing price effect on offer premium, emanating from investors' aversion to realizing nominal losses, is in addition to the 52-week-high-price effect on offer premium documented in Baker et al. (2012). These findings also imply that the target shareholders' behavioral reservation prices are revealed to the bidder during the pre-offer "behind the scenes" negotiations that the bidder conducts.

Second, there exists previous evidence (Ye, 2014) that institutional investors' average purchase price impacts merger premiums. We show that TAPP, the purchase price of all target shareholders dominates the institutional investors' average purchase price as an explanatory variable of the offer premium, probably because TAPP also incorporates the retail investors' purchase price. In a finer test, we demonstrate that both components of TAPP, retail investors' and institutional investors' average purchase prices, significantly affect merger terms, with some evidence that institutional investors' impact is stronger. Nevertheless, our finding that retail investors purchase prices also influence the offer price, refute the view that pre-merger negotiations only regard the professional institutional investors stance, i.e., that retail investors are free-riders or "followers" and have little impact on merger terms (Grossman and Hart, 1980).

Third, we find that reference prices such as purchase price and the 52-week-high do not affect directly target shareholders' merger acceptance decision. This finding suggests that bidders adjust offer prices to a point where behavioral reference prices have no residual effect on offer acceptance likelihood. In sum, it appears that reference prices affect merger decisions primarily (and practically solely) through their effect on the offer premium.

Last, we highlight our turnover based estimate of the target shareholders average purchase price, TAPP. TAPP is almost identical to the average purchase price estimate suggested by Grinblatt and Han (2005). However, we derive it using different assumptions, and we offer a more detailed derivation of our turnover-based measure. This orderly derivation affords us to extend our turnover-based measure in interesting directions such as incorporating the potential effect of high frequency machine trading. Thus, we believe that our derivation lays the ground for more advanced purchase price measures. Moreover, we compare TAPP to several other potential purchase price estimators, demonstrating TAPP superior explanatory power. Thus, we establish empirically that TAPP is a leading average purchase price estimator.

The paper is organized as follows. Section 2 reviews extant literature on merger decisions and reference price effects on these decisions. In Section 3 we present the reference prices we attempt and our testable hypotheses. Section 4 describes the sample and the data. Sections 5 and 6 summarize and discuss results of an empirical analysis of offer premium- and offer-acceptance decisions, respectively. Section 7 presents the wealth repercussions, and Section 8 concludes.

2. Background and Previous Literature

2.1. Factors Affecting Offer Premiums and Merger Decisions

Neoclassical theory predicts that mergers add value when the two companies are worth more together than apart.[3] If the two companies are worth more together, the acquirer should go ahead with the acquisition only if her gains exceed the costs. A major cost component is the premium the buyer pays above the seller's stand-alone value. In a rational world, bidders offer a price that reflects the intrinsic value of the target within the combined firm. In turn, target shareholders decide to vote for or against the proposed merger based on the price premium offered (the premium of offer price relative to the target's pre-offer stock price).

Palepu (1986) identified several target firm characteristics correlated with a bidder's decisions. Low-growth, resource-rich firms are natural acquisition targets, as well as high-growth, resource-poor firms (when funding difficulties are due to asymmetric information). Firm size is also a factor, as it correlates with the "transaction costs" associated with acquiring a firm. Such costs include those associated with the target's absorption into the acquirer's organizational framework, as well as costs associated with fighting a prolonged battle that a target may wage to defend itself. The market-to-book ratio and price-earning multiplier are also used as proxies for "cheap" buys—i.e., firms whose market values are low compared to their book values or earnings per share levels.

In a comprehensive survey on the determinants of merger decisions, Betton, Eckbo, and Thorburn (2008) pointed at several explanatory variables that are grouped into target

[3] In addition to sheer economies of scale, synergy gains can emanate from complementarity, wherein each party has what the other needs (e.g., a small firm with a unique product and a large company that can produce and market it on a large scale). Mergers also add value when a synergy gain is obtained via replacing an inefficient management.

characteristics, bidder characteristics, and deal characteristics. These include stock illiquidity (such as trading volume, and exchange listed on), the target stock price runup prior to the initial bid, and the existence of a poison pill (a shareholder rights plan allowing existing target shareholders to dilute a hostile takeover bidder). The authors also consider whether the target and bidder are related (i.e., same industry), whether the target rejects negotiations (resulting in the bid considered hostile), the form of payment (cash, stock, or combined), and whether rival bidders contest over the firm. The authors show that these factors affect offer premiums, completion rates, and offer-announcement stock returns.

2.2. Reference Price Effects on Merger Decisions

Merger decisions may also be subject to behavioral factors. For example, the basic motive for the merger may be target stock mispricing that is potentially due to shareholder irrationality. Abstracting from mispricing, Roll (1986) suggested that bidder managers may be excessively optimistic and overconfident in their own valuation of deal synergies and fail to properly account for the winner's curse. Roll's "hubris" hypothesis received support from the well-documented negative acquirer stock returns around acquisition announcements, as well as from the poor performance after acquisition announcements, as surveyed in Moeller, Schlingemann, and Stulz (2005). This evidence suggests that some mergers lack strong economic justification and are subject to agency problems and behavioral biases of the firms' top management.[4]

In the present study we focus on the impact of target shareholders' behavioral biases. Prospect theory (Kahneman and Tversky, 1979) proposes that individuals use a reference price

[4] Studies have established the dependence of merger decisions on bidder CEO personal traits, including overconfidence (Malmendier and Tate, 2008), narcissism (Aktas, De Bodt, Bollaert and Roll, 2016), gender (Levi, Li and Zhang, 2010; Huang and Kisgen, 2013; Levi, Li and Zhang, 2014), and even life experience (Bernile, Bhagwat, and Rau, 2017).

and react differently to a potential gain or loss relative to such a price. Such gain\loss asymmetry has been confirmed in controlled experiments (see, for example, Brocas, Carrillo, Giga and Zapatero, 2019). Further, the vast empirical literature on the disposition effect (Shefrin and Statman, 1985), and more recently the cognitive dissonance thesis (Kaustia, 2010; Chang, Solomon, and Westerfield, 2016; Fischbacher, Hoffmann, and Schudy, 2017; Hamdani, Lauterbach, and Mugerman, 2020), has suggested that shareholders use their share purchase price as a reference or even reservation price.

The salient and perhaps most distinctive prediction of prospect theory is that economic agents are loss averse. Rational theories tend to perceive purchase price as sunk cost and refer to current market price as the current estimate of fundamental value and the correct anchor for any economic decision. However, evidence on major individual economic decisions such as selling a house reveal that individuals are subject to behavioral loss aversion (Genesove and Mayer, 2001). Barberis and Xiong (2012) formalize the notion that sellers are averse to realizing nominal losses. The authors develop a model of realization utility, in which investors derive utility from realizing nominal gains and losses on assets that they own.

In the context of merger activity, Ye (2014) uses a measure of institutional investors' purchase price developed by Frazinni (2006) to show that the disposition effect accurately predicts public's response to a merger offer. Ye (2014) inferred whether an institutional investor is prone to the disposition effect by analyzing the investor's historical trading pattern—that is, whether the institutional investor is more ready to sell a winner than a loser. When "disposition-effect inclined" institutional investors are excluded, the impact of institutional investors' purchase price on merger decisions diminishes or disappears.

Another relevant reference price is the "52-week high". Baker, Pan and Wurgler (2012) found that recent peaks in the target stock price (and in particular the 52-week high) affect offer prices and merger completion likelihood. The offer premium increases with the ratio of the 52-week high to the pre-offer target stock price, and offer acceptance likelihood jumps when the offer price exceeds the 52-week high. Baker et al. (2012) interpreted their evidence as suggesting that the 52-week high is an important reference price for the various sides involved in the deal (including even the "neutral" advisors and financiers). For target firm shareholders, it represents a price at which they could have recently sold. Thus, in order to mitigate any regrets and convince target management and shareholders to accept a merger offer, the bidder has to adjust the offer price according to the ratio of the pre-offer target stock price to the target 52-week-high price. Interestingly, Ma, Whidbee and Zhang (2019) documented that a bidder's 52-week high also affects the offer premium, especially in deals in which bidder valuation is relatively uncertain.

In the period preceding a merger offer, the bidder and target conduct private negotiations (Boone and Mulherin, 2007; Fich, Cai, and Tran, 2011; Ahern and Sosyura, 2014). Such negotiations most probably reveal, at least partly, bidder and target behavioral reference prices.

3. Measures of the Average Purchase Price and Hypotheses

3.1. Estimating the Average Purchase Price of Target Shareholders at the Eve of the Offer

We derive and employ a turnover-based measure of all Target shareholders' weighted-Average Purchase Price (TAPP). TAPP is a weighted average of all past prices, where the weight of a particular past price approximates the proportion of shareholders that bought the share at that price and held it until the eve of the offer. Our measure is based on the Proportional Trading Model

(PTM), frequently used by courts in class-action suits for assessing the damage caused by a security fraud – see Furbush and Smith (1994), Skinner (1997) and Lowry and Shu (2002).

We extend the PTM in the direction of estimating the average purchase price. In our measure, TAPP, the weight assigned to a particular past price considers both the daily turnover on that past day, as well as the turnover from that past day until the eve of the offer, where the latter accounts for the attrition over time in veteran investors' holdings. In Appendix A we derive TAPP. The resulting formula is:

(1) $\mathrm{TAPP}_{i,T} = \sum_{t=2}^{T} \alpha_{i,t}^{T} \cdot P_{i,t} + \left(1 - \sum_{t=2}^{T} \alpha_{i,t}^{T}\right) \cdot P_{i,1}$, where

(2) $\alpha_{i,t}^{T} = \mathrm{x}_{i,t} \cdot \prod_{k=t+1}^{T}(1 - \mathrm{x}_{i,k})$,

where t is a counter of stock i's day of trade on the exchange, t = 1 is the stock's first day of trade on the exchange and t=T is the merger offer date, $P_{i,t}$ is the price of stock i on the exchange on day t, and $\mathrm{x}_{i,t}$ is the daily turnover of stock i on day t, i.e., the proportion of stock i's outstanding shares traded on day t.

The TAPP measure, Eq. (1), weights each past trading-day price according to its α, which is its share in shareholding at the focal day T (the merger offer date in our case). The remaining weight, unaccounted by the sum of α's, is then attributed to the price of stock i on its first day of trade on the exchange. Notably, TAPP is identical to the turnover-based purchase price estimator suggested in Grinblatt and Han (2005) Eq. (9). However, Grinblatt and Han (2005) use different assumptions for deriving their formula, and in practice limit past price data to five years, which we do not. Our derivation also suggests some valuable extensions of the estimator.

3.2. Other Purchase Price Estimators

We examine several other average purchase price estimators besides TAPP. The first couple of additional estimators are less sophisticated than TAPP. They are AVG_PP, a simple average of all past stock prices, and WAVG_PP, a turnover weighted average of all past stock prices. The exact definitions of these estimators are:

(3) $\text{AVG_PP}_{i,T} = \sum_{t=1}^{T} \frac{1}{T} \cdot P_{i,t}$, and

(4) $\text{WAVG_PP}_{i,T} = \sum_{t=1}^{T} x_{i,t} \cdot P_{i,t} \; / \; \sum_{t=1}^{T} x_{i,t}$,

where, as before, $P_{i,t}$ is the price of stock i on the exchange on trading day t, and $x_{i,t}$ is the daily turnover of stock i on day t. AVG_PP and WAVG_PP are designed to examine the importance and contribution of the following two assumptions we employed in our average purchase price estimator TAPP: (i) the price on day t in the past has to be weighted by the turnover on that day, and (ii) the attrition in investor holdings since day t can be assessed using the Proportional Trading Model. Comparing TAPP and AVG_PP performances as purchase price estimators tests the usefulness of both above assumptions together, while comparing TAPP and WAVG_PP performances examines the efficacy of the PTM assumption alone.

One can criticize the PTM assumption that every shareholder trades every day or sells a proportion of her holdings every day. However, for average purchase price estimation we only need to describe the aggregate behavior of shareholders who purchased the stock on any past day; thus, PTM becomes more palatable. Another possible criticism is that there exist at least two classes of shareholders. The first class encompasses short-term traders: day traders and algorithm-driven machines that flip stocks on a relatively high frequency, while the second comprises the classic relatively "long-term" investors. Barclay and Torchio (2001) examine more elaborate

trading models, including models with two types of shareholders (passive and active) and models allowing recent purchasers of the stock to have a higher or lower likelihood of selling the stock by date T. In their tests, none of these more elaborate models outperformed the PTM in litigation cases, hence Barclay and Torchio (2001) recommend sticking with the PTM.

In the context of merger decisions, distinguishing between short-term and long-term investors becomes more crucial, as the average purchase price of long-term investors is the one that counts for merger decisions. Our basic TAPP estimator disregards "high frequency" traders and considers all daily volume as the purchases and sells of long-term investors. This wrong attribution of trade may bias the TAPP estimator. We therefore construct several competitors for TAPP, based on the existence of a class of "active" short-term investors.

Chordia, Roll and Subrahmanyam (2011), for example, suggest that High Frequency Trading (HFT) accounts for around 50% of the daily volume. Consider a stock in which half of the daily volume is conducted by robots and day traders. Suppose the daily volume on day t is 1000 shares. Short-term traders buy in the morning 250 shares from long-term investors, and sell these shares back to other long term investors later during the day. This generates a total volume of 500 shares. Another 500 shares are traded between long-term traders. In such a scenario, the relevant long-term daily trade can be summarized as 750 – the number of shares that eventually changed hands (500 directly and 250 with the intermediation of short-term traders). If long-term shareholders are the one who determine the response to merger offers, the relevant volume for assessing purchase price is 750 shares, 0.75 of the reported daily volume. It appears that in our calculations of TAPP we should factor the reported daily turnover $x_{i,t}$ by 0.75.

In sum, if two classes of traders exist, and the above trading behavior is assumed, a more appropriate estimator of the average purchase price might be:

(5) $\text{TAPP_75}_{i,T} = \sum_{t=2}^{T} A_{i,t}^{T} \cdot P_{i,t} + \left(1 - \sum_{t=2}^{T} A_{i,t}^{T}\right) \cdot P_{i,1}$, where

(6) $A_{i,t}^{T} = 0.75\text{x}_{i,t} \cdot \prod_{k=t+1}^{T}(1 - 0.75\text{x}_{i,k})$.

Computationally, the TAPP_75 formulae are identical to the TAPP formulae in Equations (1) and (2) with the daily turnover $\text{x}_{i,t}$ replaced by $0.75\text{x}_{i,t}$. In our empirical work we also compute and examine TAPP_87.5 that replaces daily turnover $\text{x}_{i,t}$ by $0.875\text{x}_{i,t}$. This represents a more modest short-term traders' participation in stock trading. In any case, note that factoring down the reported daily turnover of the stock has a non-trivial impact on the estimated average purchase price. It increases the weight assigned to remote past trading days at the expense of the weights of recent prices. [5] This change in weights generates a wedge between TAPP and TAPP_75.

Last, we follow Frazzini (2006) and Ye (2014) in estimating the Institutional Investors Average Purchase Price (IIAPP, in short). This measure relies on quarterly filings of institutional investor holdings. Appendix B provides a detailed derivation of the IIAPP.

IIAPP, the institutional investors' average purchase price, may misrepresent all investors' average purchase price. The "all investors" universe also includes retail/individual investors who may behave (trade and hold shares) differently than institutional investors (Shapira and Venezia, 2001; Barber and Odean, 2002; Dhar and Zhu, 2006; Barber and Odean, 2008; Lauterbach and Mugerman, 2020). Thus, the IIAPP may misestimate all investors' average purchase price, especially for stocks in which institutional investors' total holdings are relatively modest (i.e., account for only a small proportion of the stock's outstanding shares).

[5] Formally, consider the ratio of the weight of the current day, day T, to a past day, day t. According to TAPP this ratio is $\frac{\text{x}_{i,T}}{\text{x}_{i,t} \cdot \prod_{k=t+1}^{T}(1-\text{x}_{i,k})}$, while according to TAPP_75 it is $\frac{\text{x}_{i,T}}{\text{x}_{i,t} \cdot \prod_{k=t+1}^{T}(1-0.75\text{x}_{i,k})}$. Since $\prod_{k=t+1}^{T}(1 - 0.75\text{x}_{i,k})$ is higher than $\prod_{k=t+1}^{T}(1 - \text{x}_{i,k})$, the discussed ratio is lower when the TAPP_75 estimator is employed. The lower ratio obtained in the TAPP_75 estimation demonstrates that relative to TAPP, TAPP_75 shifts weights systematically back in time - from recent to more remote past prices.

Now that we have at our disposal a purchase-price measure for all target shareholders, TAPP, and another one for institutional investors only, IIAPP, we can compute Retail_APP, an estimate of the average purchase price of retail investors. If we assume that TAPP is a weighted average of IIAPP and Retail_APP, then

(7) $\text{TAPP}_{i,T} = w^{T}_{INST,i,t} \cdot IIAPP_{i,T} + \left(1 - w^{T}_{INST,i,t}\right) \cdot Retail_APP_{i,T}$,

where $w^{T}_{INST,i,t}$ is the proportion of firm i shares held by institutional investors on merger offer eve (time T). Retail_APP can be readily extracted from Eq. (7)

3.3. Hypotheses

Previous empirical studies have demonstrated that behavioral reference prices such as Baker et al.'s (2012) 52-week high and the weighted purchase price of institutional investors (Ye, 2014) affect the merger offer premium as well as the offer acceptance likelihood. We expect the target average purchase price (TAPP) to be a relevant and influential reference price as well. Accordingly, we propose:

Hypothesis 1: The merger offer premium depends on the ratio of the target shareholders' average purchase price (TAPP) to the pre-offer target-stock price.

Practically, we propose that the bidder will adjust the offer price upwards when the pre-offer target price is below the TAPP in order to mitigate the "loss" feelings of most target shareholders. Conversely, when target shareholders are in profit (the pre-offer target price exceeds TAPP), the bidder may try to shear off some of the offer premium, capitalizing on the winning sentiment of the target shareholders. In fact, Prospect Theory and its S-curve utility function predict a non-linear relation between TAPP and the offer premium. We will therefore divide the loss (gain) domain into three equal subsamples (Small, Medium and Large losses or gains), and

construct a piecewise regression to test whether the marginal increase (decrease) in offer premium decreases with the loss (gain) size, as predicted by Prospect Theory.

TAPP comprises institutional and retail average purchase prices (IIAPP and Retail_APP, respectively). It is arguable that only institutional investors' stance is influential in the pre-offer negotiations determining the merger offer price. We propose that retail investors' loss aversion concerns are also taken into account when determining the offer price, in which case

Hypothesis 2: Retail investors average purchase price also impacts the offer premium.

Our third hypothesis, based on previous research of reference prices, is as follows:

Hypothesis 3: The merger-offer acceptance likelihood is higher when the offer price exceeds the target shareholders' average purchase price (TAPP).

This hypothesis relies on the assumption that target shareholders are averse to realizing nominal losses, and are therefore less likely to accept an acquisition bid if the price offered is lower than their purchase price. All else equal, acceptance likelihood should be negatively correlated with nominal loss. However, on reflection this hypothesis is not that obvious. According to our Hypothesis 1, bidders agree to adjust the offer price upwards in order to facilitate a positive target shareholder vote. If so, then the offer price, at least in part, is endogenously determined by the purchase price. The marginal effect of TAPP on acceptance thus depends on the extent to which premium adjustments offset the effect of purchasing price concerns. If premium adjustments in response to nominal losses are sufficiently high, the marginal effect of TAPP on offer acceptance would become economically insignificant.

Any behavioral extra premium offered to target shareholders will transfer wealth from acquirer to target firms. Hence

Hypothesis 4: The behavioral related extra offer premiums increase target stock gain upon merger offer announcement at the expense of the acquirer stock price.

Riley, Summers, and Duxbury (2020) show that reference points are determined not only by the purchase price, but also by salient points in the prior share price path. Baker et al. (2012) demonstrate the effect of the pre-offer 52-week high price on merger decisions, and conjecture that it represents target shareholders' response to their "perceived losses" (not selling at the 52-week high). Regrets over missing a peak price, i.e., perceived losses, are different from the actual losses relative to the purchase price. Thus, we expect TAPP to have an impact on shareholders' decisions that is complementary and additive to that of the 52-week high price. We propose:

Hypothesis 5: The TAPP effect on the merger offer premium and the merger completion likelihood does not subsume the effects of the 52-week high reference price.

4. Sample and Data Description

4.1. Sample Construction

We examine all mergers of U.S. public firms between 1990 and 2019 available on the SDC M&A (by Thomson Reuters) database. Our detailed data on the offers and deals (such as offer price, form of payment, and more) come from this SDC file. Our purchase-price measures are constructed using daily stock prices and volumes extracted from the Center for Research in Security Prices (CRSP) files, except for IIAPP that utilizes institutional ownership data from 13F filings of institutional investors retrieved from Thomson Reuters. Last, various firm characteristics and accounting data are collected from Compustat.

Similar to previous studies, we exclude divestitures, repurchases, self-tenders, and rumored deals, as well as any offers for which the offer price is missing on the SDC database. Following

Bates, Becher, and Lemmon (2008), in cases of multiple deals involving the same target and bidder in the same year, we include only the initial bid. Following Gompers, Ishii and Metrick (2003) and Bebchuk, Cohen, and Ferrell (2009), we exclude deals in which the target firm is dual-class, as it is difficult to track down the bid structure across different share classes. Last, there are a few well-documented issues with merging our data sources: CRSP only covers major stock exchanges (NYSE, AMEX, NASDAQ), Compustat only covers firms with stock market capitalization above $100 million, and 13F filings do not account for short positions. Our final sample comprises 4910 merger offers.

4.2. Descriptive Statistics of the Merger Offers

Figure 1 depicts the yearly distribution of merger offers in our sample, spanning from 1990 to 2019. The number of offers per year varies from 65 in 1992 and 2019 to 427 in 1999. The average (median) number of offers is 164 (125). There is a surge in merger activity in the late 1990s, followed by a relatively calm activity period in the twenty-first century (with two local spikes in 2007 and 2015).

[Insert Figure 1 and Table 1 about here]

Table 1 describes the sample firms and merger offer characteristics. All variables are winsorized at their 2.5% and 97.5% levels and refer to the fiscal year preceding the merger offer. We first review the target firm characteristics. The mean total assets of our target firms are approximately $1.3 billion U.S. dollars, yet the median is only $300 million U.S. dollars. Target firms' profitability is relatively poor, with a mean return on assets of about -0.03 (median is 0.01), yet the mean sales growth of about 20% (median is 10%) appears relatively solid. The mean leverage (debt divided by total assets), 0.16, is relatively modest. Target firm stock prices

demonstrate a mean price earnings ratio of 11.1 (median is 12.5) and a mean market-to-book value ratio of 2.5 (median is 1.7).

Table 1 also reviews our bidder firms. The sample size decreases to 3,816 mainly because the bidder is either a small U.S. public firm or a public foreign firm. (Such firms are not covered by CRSP and Compustat.) On average, bidder firms are much larger than target firms. Their mean total assets of $12.8 billion U.S. dollars are almost ten-fold that of target firms. Bidder firm mean and median return on assets of 0.03 is also higher than that of target firms. The mean sales growth of bidder firms is 25%, slightly higher than that of target firms. Bidder firm leverage is similar to that of target firms, with an average debt-to-total assets ratio of 0.16. It is also evident that bidder stock pricing is significantly higher than that of the target stock, with a mean price-earnings ratio of 19.1 and a mean market-to-book ratio of 3.4 (compared to 11.1 and 2.5 in target firms, respectively). Last, it is interesting to note that the mean number of previous merger offers made by a bidder firm in our sample is 1.46. Apparently, some bidders are prolific, and use mergers repeatedly as their growth strategy. We find that the upper decile of our 2,432 unique bidders made 1,492 (about 30% of the) merger offers, and the top bidder made 29 offers. We control for experienced bidders in our empirical analysis.

On the bottom of Table 1 we review some of the merger offer characteristics. Thirty-six percent of the offers are cash-only (promise the entire payment in cash), 35% are shares-only offers, and the rest offer some mix of cash and securities or their method of payment is unknown (missing in SDC files). The vast majority of the merger offers, 93.8%, are friendly—i.e., the offers are negotiated, agreed upon, and recommended by target and bidder managements and board of directors. Interestingly though, only 86.7% of the merger offers are eventually completed and result in an actual merger deal. Also interesting, in about 33% of the merger offers the bidder and

target are from different industries, representing "diversifying" merger attempts, and in about 7% of the cases we find multiple bidders (for the same target firm) contemporaneously.

Table 2 reviews several price ratios that are potentially relevant for the merger offer. To mitigate the effect of outliers, we winsorize all price ratios at the 2.5% and 97.5% levels and employ a natural log transformation (Ln) of the price ratios. The first price ratio examined is the offer premium, assessed as the ratio of the merger offer price to the target-stock market price 21 trading days before the offer announcement date (day A-21, henceforth). We choose the stock price 21 trading days (roughly a calendar month) prior to the offer announcement as our baseline price, following observations of an upward drift in target-company stock price in that month. This drift, probably due to information leaks, is part of the merger premium, thus we account for it. The mean offer premium is about 32%, and it is identical to the mean premium reported in Table 2 of Baker et al.'s (2012) sample of mergers and acquisitions.

We further distinguish between failed offers and accepted offers (i.e., completed deals). Interestingly, the mean offer premium is only slightly and insignificantly higher in accepted offers. This finding indicates that the relation between offer premium and offer acceptance likelihood is less identifiable than initially perceived.

[Insert Table 2 about here]

The rest of the price ratios in Table 2 are related to potential behavioral effects. The mean (median) Ln of the TAPP ratio to the target stock price on day A-21 is 0.052 (-0.028). This indicates that roughly half of the merger offers arrive when target shareholders are, on average, at a "loss". The means of the five other Ln (Average purchase prices ratio to the target stock price on day A-21) are slightly positive and range between 0.01 and 0.10, while the medians of these ratios are negative, reinforcing the above finding that in more than half of the cases when the offer arrives

target shareholders are in a loss situation relative to their average purchase price. Last, the mean Ln of the ratio of the target stock pre-offer 52-week high price to the target stock price on day A-21 is 0.338, compared to 0.348 in Baker et al. (2012), which demonstrates that many stocks trade markedly below their yearly high at the time of the merger offer. Notably, we compute all our reference prices (the alternative average purchase price estimates and the 52-week high) on day A-21. i.e., we use past prices only up to day A-21. This creates some consistency – merger offer price as well as the various reference prices are assessed at and compared to the stock market price on day A-21.

Table 2 also shows the mean reference price ratios in failed and accepted offers. For all behavioral price ratios, the mean is significantly higher in failed offers. This suggests that if, at the time of the offer announcement, target shareholders have deeper losses relative to their reference prices (purchase price and 52-week high price) the offer completion likelihood diminishes.

The bottom row in Table 2 regards a bidder reference price ratio, which is the ratio of the bidder stock pre-offer 52-week high price to the bidder stock price 21 trading days before the offer announcement (day A-21). Ma et al. (2019) found that the merger premium is negatively correlated to this price ratio, and the effect emanates from the subsample of offers involving payment in shares (see Table 6 in their paper). It appears that the bidders whose stock trades close to its 52-week high price are more generous to target shareholders, perhaps because they think their stock price is inflated and do not mind paying others with it. The mean Ln of the ratio of the bidder stock pre-offer 52-week high price to the bidder stock price on day A-21 is 0.194, much lower than its counterpart in target stocks. This suggests that the bidder firm stock is, on average, in relatively better shape at the time of the offer than the target firm stock. Interestingly, in failed offers this bidder price ratio is significantly higher than in completed merger deals, suggesting that target

shareholders are more reluctant to merge with a bidder company that is far from its peak. However, no conclusions can be drawn without a more rigorous formal analysis.

5. Reference Price Effects on the Offer Premium

5.1. The Impact of Target Shareholders' Reference Prices

Table 3 examines the reference price effects on the merger offer premiums, using each reference price separately. The main regression specification is:

(8) $$Offer_{Prem} = \beta_0 + \beta_1 Ref_Price_{Prem} + D'\gamma + T'\delta + Fixed + \varepsilon,$$

where the dependent variable $Offer_{Prem}$ (offer premium) is defined as Ln($\frac{\text{offer price}}{\text{stock price A}-21}$), and stock price A-21 is the stock price 21 trading days prior to the offer announcement date. The key explanatory variable Ref_Price_{Prem} is the premium of the reference price relative to stock price A-21; hence, for example, *TAPP_Prem* = Ln($\frac{TAPP}{\text{stock price A}-21}$). For brevity, in Table 3 we examine only two reference prices: the 52-week high and TAPP. Among the control variables employed, D' is a vector of deal characteristics, T' is a vector of target firm characteristics, *Fixed* represents calendar year fixed effects and industry fixed effects, and ε is an error term clustered at the target firm level.

The first two columns in Table 3 aim to establish our benchmark regression, encompassing the effect of non-reference price factors (i.e., various deal and target characteristics) on the offer premium. The first regression uses explanatory variables mentioned in previous research (see our review in Section 2.1), while the second regression, in Column (2), is its parsimonious form. The parsimonious regression shows that target characteristics such as target size, as well as deal characteristics such as the form of payment, affect the offer premium. For brevity, we carry over

only the premium determinants that appear significant prior to introducing reference prices.

[Insert Table 3 about here]

Columns (3) and (4) review the effect of the TAPP premium on the offer premium, essentially testing our Hypothesis 1. In Column (3) we show that consistently with Hypothesis 1 the TAPP premium (the natural logarithm of the TAPP ratio to the pre-offer stock price) is significantly positively correlated with the offer premium. This establishes that shareholders' purchase price, approximated by the TAPP, is a relevant reference price with material effects on the offer premium.

The positive relation between the offer premium and TAPP_Prem implies that when shareholders are in a "loss" situation (the average purchase price TAPP is higher than pre-offer price) the bidder offers a higher premium ceteris paribus. We can think of a rational model consistent with it. For example, in a world with heterogeneous and slow-adjusting expectations about the share value, current shareholders might still place some weight on their original purchase-date valuation of the stock. Now, a bidder trying to convince shareholders to sell their stocks (agree to a merger) has to consider current shareholders' valuation of the target stock and introduce a measure of the purchase price such as TAPP. However, note that such a rational model requires the assumption of "stubborn" shareholders that maintain their past valuations (generated at their purchase date) and are slow in adjusting their valuations of the stock. The consistency of such an assumption with rational behavior is questionable. Thus, it is unclear to us whether a rational model can account for the documented evidence and what are its exact testable predictions.

Behavioral explanations for the relation of TAPP to offer premium are more direct and offer sharp predictions. First, the loss-aversion of shareholders dictates an upward revision in the offer premium when investors are in loss (TAPP_Prem is negative). Further, assuming an S-curve

utility function (a-la Prospect Theory), shareholders' marginal utility loss diminishes as the loss increases, which implies higher marginal compensation for small (close to zero) losses. In short, behavioral models predict a non-linear relation between TAPP_Prem and offer premium.

Baker et al. (2012) argue that estimating the non-linear effect of behavioral reference prices on the offer premium requires a piecewise regression. Accordingly, we divide all cases with gains (pre-offer price larger than the TAPP) into three equal subsamples (small, medium, and large gains), in which the cutoffs between these three subsamples are gains of 0.109 and 0.241. Similarly, we divide all loss cases (pre-offer price smaller than the TAPP) into three equal subsamples, with cutoffs losses of 0.121 and 0.366 that separate them. We then construct six TAPP_Prem variables, three for positive TAPP_Prem (loss situations) and three for negative TAPP_Prem (gain situations). These new explanatory variables are denoted as Positive_TAPP_Prem_X where X is small, medium, or large, and Negative_TAPP_Prem_X where X is small, medium, or large. To illustrate, Positive_TAPP_Prem_Small is set equal to 0 when TAPP_Prem is negative, equal to TAPP_Prem when $0 < \text{TAPP_Prem} \leq 0.121$, and equal to 0.121 when $\text{TAPP_Prem} > 0.121$; Positive_TAPP_Prem_Medium is set equal to 0 when $\text{TAPP Prem} \leq 0.121$, equal to TAPP_Prem minus 0.121 when $0.121 < \text{TAPP_Prem} \leq 0.366$, and equal to 0.245 (=0.366-0.121) when $\text{TAPP_Prem} > 0.366$; Positive_TAPP_Prem_Large is set equal to 0 when $\text{TAPP Prem} \leq 0.366$, and equal to TAPP_Prem minus 0.366 when $\text{TAPP_Prem} > 0.366$. Similar logic governs the construction of the piecewise Negative_TAPP_Prem variables in which the cutoffs between small, medium, and large Negative_TAPP_Prems are -0.109 and -0.241.

The results of the piecewise regression, reported in Column (4), are consistent with prospect theory. The coefficient of (or marginal compensation for) small losses is larger than that of medium and large losses, supporting diminishing marginal compensations for losses. Only the

marginal compensations for small and medium losses are statistically significant at the 1% and 10% levels, respectively. This evidence adds to the basic evidence in Column (3) by demonstrating that the relation between perceived losses and the offer premium is non-linear: offer premiums are higher when losses are deep, yet the compensation for deep losses as a proportion of the loss is smaller than the corresponding proportional compensation (=adjustment of offer price) for relatively small losses.

The coefficients of the three Negative_TAPP_prem variables are also interesting, representing gain situations. Consistent with prospect theory, they also decrease as the gain increases. Only the small and medium coefficients are statistically significant at the 5% level. Given that in gain situations the TAPP_Prem is negative, the positive coefficients in such situations imply that when target shareholders are in a gain situation on the eve of the offer, they obtain a less generous or trimmed offer premium. Apparently, the bidder cuts the offer premium as the investment in target stock becomes more profitable for the target shareholders. Hence, bidders are not only "considerate" regarding target shareholders' losses, but also somewhat "exploitative" when target shareholders are in gain situations. However, it is noteworthy that in our more advanced analyses, reviewed later in this paper, the coefficients of TAPP_Prem in gain situations become small and statistically insignificant. Thus, the compensation that target shareholders receive in loss situations is much higher than any deduction in premiums in gain situations. This is also consistent with Prospect Theory which suggests that the loss segment of the S-shape individual utility function is much steeper than the gain segment.

Baker et al. (2012) proposed and advocated the pre-offer 52-week-high price of target stock as a pertinent reference price for merger offers. Thus, in Columns (5) and (6) we present results of regular- and piecewise-offer premium regressions that employ the 52-week-high premium

(HIGH_Prem) as explanatory variables. Note that HIGH_Prem is by definition non-negative because the pre-offer 52-week-high price is always at least equal to the pre-offer target price. Accordingly, in the piecewise regressions we use only three positive HIGH_Prem variables, representing small, medium, and large perceived losses relative to the 52-week high, with cutoffs of 0.100 and 0.349 between them.

Column (5) verifies Baker et al.'s (2012) evidence that the 52-week-high price is a relevant reference price. The higher the HIGH_Prem—the perceived target shareholders' loss on the eve of the merger offer—the higher the offer premium, ceteris paribus. The bidder appears to partially compensate target shareholders for their regrets regarding missing the opportunity of selling their holdings at the 52-week-high price.

The piecewise regressions are also consistent with Baker et al.'s (2012) evidence and with the predictions of prospect theory. The coefficient of (or marginal compensation for) small losses relative to the 52-week high is larger than that of medium and large losses, supporting diminishing marginal compensations for perceived losses. This illustrates that the relation between offer premium and the perceived loss relative to the 52-week high is non-linear with smaller losses commanding a more generous proportional compensation.

5.2. The Choice between Alternative Average Purchase Price Measures

In Panel A of Table 4 we attempt six alternative average purchase price measures: 1) TAPP, the measure we propose; 2) IIAPP, the institutional investor average purchase price; 3) AVG_PP, a simple average of past stock prices; 4) WAVG_PP, the turnover weighted average of past prices; 5) TAPP_75, a TAPP-like measure factoring down daily turnover by 0.75 (to emulate the existence of short-term high-frequency traders); and TAPP_87.5, a TAPP-like measure factoring daily turnover by 0.875.

[Insert Table 4 about here]

The first salient result in Panel A is that the more "primitive" average purchase price measures, AVG_PP and WAVG_PP lag far behind in their explanatory power, as the regressions using them attain markedly lower adjusted-R_squared. The only difference between the WAVG_PP and TAPP measures is the PTM assumption of the TAPP measure. Hence, our evidence in Table 4 of a superior explanatory power of TAPP illustrates that the PTM assumption of our TAPP measure contributes much to assessing a relevant average purchase price measure.

The second salient result in Panel A is that TAPP achieves the highest adjusted R-squared.[6] Thus, it is superior not only relative to the simple purchase price estimators but also relative to the more sophisticated ones: the institutional investor purchase price (IIAPP) estimator and the two more elaborate TAPP-style measures that take into account the class of short-term traders.

The finding that the more-elaborate TAPP-style estimators, TAPP_75 and TAPP_87.5, fail to increase explanatory power is somewhat surprising. It is clear that the recognition of these more elaborate models in day-traders and machine trading makes these estimators more realistic. Nevertheless, the bottom line is that these alternative average purchase price estimators achieve lower explanatory power than TAPP. Barclay and Torchio (2002) also conclude that elaborating the PTM model by introducing short-term trading does not improve prediction quality (damage assessment in their case).

The apparent explanatory superiority of TAPP over IIAPP is important also as a test of Hypothesis 2. If retail investors are insignificant and negligible players in the pre-merger negotiations, their average purchase price would not count, and IIAPP would be a more accurate

[6] All our conclusions in the paper remain intact when alternative goodness of fit measures such as the Akaike or Bayesian Information Criteria are employed.

estimate of the relevant purchase price and have at least the same explanatory power as TAPP. On the other hand, if, as Hypothesis 2 predicts, retail investors' average purchase price is also important and impacts offer premium, then TAPP, that as all investors' average purchase price incorporates retail investors, would dominate IIAPP that considers institutional investors only. The finding that TAPP has more explanatory power than IIAPP suggests that the sectorial IIAPP is a partial and imprecise estimate of the relevant purchase price. On reflection, this result is not surprising. Almost 94% of our sample mergers are friendly, that is merger terms are negotiated with target firm's management who might recognize and be considerate of its retail shareholders' characteristics and activism (as well as of its institutional investors shareholders).

Panel B of Table 4 offers a more direct test of retail investors' importance. Sample size decreases to 4,464 mergers as we excluded mergers with minute (less than 5%) retail holdings where Retail_APP cannot be reliably computed. The first two columns present the TAPP and IIAPP piecewise regressions in the reduced sample. The results resemble those in Panel A, and in particular, TAPP manifests superior explanatory power.

Column (3) reports the results of piecewise regressions with Retail_APP. Recall that we impute Retail_APP by assuming that TAPP is a weighted average of IIAPP and Retail_APP. The usual pattern appears. Retail investors' losses relative to their average purchase price are compensated in a way that conforms to Prospect Theory's S-curve utility. This finding supports Hypothesis 2. However, the compensation for small retail investor losses appears milder than the compensation for small losses of institutional investors, as evidenced by the coefficients of 0.222 and 0.345 in columns (2) and (3), respectively.

Column (4) summarizes piecewise regressions with both IIAPP and Retail_APP. We find that both institutional and retail investors' average purchase prices demonstrate the recognized

compensation for losses pattern with statistically significant compensations (i.e., offer premium increases) for small losses. Again, the compensation for institutional investor losses appears larger. This finding may indicate that during merger negotiations institutional investor stance is more heavily weighted. Institutional investors are more professional, each of them holds larger positions than a retail investor, and they are more vocal in merger negotiations. Hence, institutional investor's stance probably receives a higher attention in merger negotiations. The interesting finding though is that, consistent with Hypothesis 2, retail investors' losses are also considered, despite the fact that previous literature regards them as "free riders" (Grossman and Hart, 1980).

The thesis above that institutional investors may have a larger impact on the offer premium than retail investors is examined in Columns (5) and (6). We find that when institutional investor weight in shareholding is above median (INST_HIGH in Panel B), the compensation for institutional investor losses is much stronger than when institutional investor holdings are below median (INST_LOW in Panel B). Consistently, the compensation for losses of retail investors is statistically significant only when institutional investor holdings are low. This evidence supports the contention that institutional investors' power increases the compensation for their losses (in case such losses exist).

Notably, the explanatory power of TAPP in Column (1) is superior to that of the formulation with retail and institutional average purchase prices separately shown in Column (4).[7] Thus, in the remainder of the paper, we will employ TAPP as our sole purchase price estimator.

[7] For example, the difference in the Bayesian Information Criterion between these two models provides "very strong" evidence in favor of the model with TAPP.

5.3. Are the Reference Prices Mutually Exclusive?

Table 5 examines whether the effects of HIGH_Prem and TAPP_Prem are complementary, that is, co-exist side by side, as our Hypothesis 5 predicts. In Column (1), we use both TAPP_Prem and HIGH_Prem as explanatory variables, and each scores a positive and statistically significant coefficient. The coefficients of TAPP_Prem and HIGH_Prem in Column (1) are smaller than their respective coefficients in Columns (3) and (5) of Table 3 in which we examine the stand-alone effect of each. This is probably due to the correlation between TAPP_Prem and HIGH_Prem that equals 0.80. The use of both reference price premiums increases the adjusted-R^2 of the offer premium regression relative to the corresponding single-reference price versions in Table 3, suggesting that their effects are complementary. Bidders appear to take into account both target shareholders' actual nominal loss (represented by TAPP_Prem) and their perceived loss relative to a salient price they could recently sell for (represented by HIGH_Prem).

The piecewise regressions in Column (2) reinforce our previous findings that: (1) bidders take target shareholders' behavioral factors (mental accounting and regretful feelings) into account; (2) the marginal compensation (increase in offer premium) for actual losses (losses relative to TAPP) and perceived losses (losses relative to the high price) are diminishing in loss size; and (3) the cut in offer price when target shareholders are in gain is smaller than the increase in offer price when they are in loss. In fact, the only difference between Column (2) of Table 5 and Table 3 evidence is that the gain-related coefficients become statistically insignificant. The main conclusion remains, however, intact: the findings of the piecewise regression support Hypothesis 5 that the purchasing price and 52-week high price effects are separate and complementary effects.

[Insert Table 5 about here]

Last, Columns (3) and (4) add, as a robustness test, IIAPP_Prem to the regressions. In the presence of TAPP_Prem and High_Prem the coefficients of IIAPP_Prem become statistically insignificant. Furthermore, in Columns (3) and (4) we attain the same adjusted R^2s as in Columns (1) and (2). Thus, we conclude that High_price and TAPP adequately represent the target-shareholders-associated reference price effects on a merger offer price.

5.4. The Impact of Adding Bidder Attributes and Reference Prices

Since the merger offer premium is decided by the bidder, bidder characteristics, and behavioral biases might impact it as well. Bidder characteristics such as size, profitability, growth and leverage might shape a bidder's perspective and opportunity set and thus impact the offer premium. A bidder-related reference price effect might also emerge. Ma et al. (2019) documented that the premium offered in non-cash M&A deals is higher the closer the bidder's stock price is to its 52-week high. This phenomenon is routed in both bidder and target perspectives. When bidder stock pre-offer price is close to its 52-week high, the bidder's stock might be overvalued, thus bidders willingly offer (and target shareholders rationally demand) a higher premium in deals involving payment in bidder shares. In addition, when the bidder's stock is close to its 52-week high, bidder managers are more prone to hubristic behavior that can lead them to offer inflated premiums (Roll, 1986).

Table 6 summarizes regressions of offer premiums on deal-, target- and bidder-characteristics. Deal and target characteristics are as in Table 5, and bidder characteristics include: bidder size, leverage, ROA, sales growth, price-earnings ratio, market-to-book ratio, and merger experience (= number of previous merger offers). The premium of the bidder's 52-week high price relative to the bidder's stock price 21 days before the offer, possibly a behavioral effect, is also added as an explanatory variable. The sample size in Table 6 is about a quarter less than in Table

5 because of missing bidder information. All bidders are public firms, yet some are foreign and others are not covered by CRSP or Compustat (probably due to their small size).

[Insert Table 6 about here]

Column (1) replicates the non-piecewise regression with HIGH_Prem and TAPP_Prem. The results are almost identical to those documented in Column (1) of Table 5 for the larger sample used there. Column (2) adds bidder characteristics and Column (3) presents the parsimonious form that includes bidder characteristics. It appears that experienced bidders slightly decrease their offer premium, perhaps in response to the negative bidder abnormal returns typically recorded around merger offer proposals. High leverage also lowers the offer premium, possibly because of creditor restrictions. In contrast, relatively large, profitable, and highly-valued bidder firms (that manifest relatively high total assets, ROA, and market-to-book ratios) tend to offer higher premiums, perhaps because such strong firms are able to extract larger synergy gains from the merger deal.

In Column (3) we also examine the effect of the Bidder_High_Prem, the premium of the bidder stock's 52-week high price over its pre-offer price. The coefficient of Bidder_High_Prem is negative and statistically significant. Consistent with Ma et al. (2019), when the bidder stock is close to its 52-week high just before the merger offer, the bidder's offer tends to be more generous.

Ma et al. (2019) also claimed this effect is cardinal in non-cash deals. Thus, in Column (4) regressions, we add an interaction term between cash deals and Bidder_High_Prem as an explanatory variable. The results are clear-cut. The coefficients of Bidder_High_Prem and its interaction with cash deals are opposite in sign, statistically significant, and almost equal in absolute value, implying that the extra premium offered when the bidder stock price is close to its 52-week high is limited to non-cash deals only. This suggests that when the bidder stock price is over-valued (or there is a suspicion that it is over-valued) and the bidder proposes to pay target

shareholders with it, the bidder is willing to pay (or target shareholders demand, respectively) a higher offer premium. The fact that for cash offers there is no effect of the ratio of the pre-offer bidder stock price to its 52-week high may also indicate that the documented effect of this bidder stock price ratio is not a result of bidder management hubris. However, we do not argue and cannot rule out the proposition that the Bidder_High_Prem effect is related to or representative of a behavioral bias.

Column (5) presents the results of a piecewise premium regression including the significant bidder-related variables. The results are similar to the comparable regression in Column (2) of Table 5, yet the explanatory power (adjusted-R^2) improves substantially. Most importantly, our conclusions about the impact of the various reference prices remain intact.

5.5. The Economic Impact of Losses Relative to Reference Prices

Our most-developed empirical analysis, summarized in Column (5) of Table 6, can be used to examine the economic significance of the reference price effects, i.e., the extra premium offered when target shareholders are in a loss situation. The magnitude of the compensation for a loss of Y% relative to TAPP (52-week high) is assessed by multiplying the corresponding levels of the three Positive_TAPP_Prem_X (HIGH_Prem_X) variables by their regression coefficients reported in Column (5). Recall that the specification of the three levels is incremental by design in order to capture the marginal effect in each of the three regions.

For example, suppose on the eve of the offer, target shareholders are in a loss of 10% relative to TAPP and 15% relative to the 52-week high. In this case: Positive_TAPP_Prem_Small = 10%, Positive_TAPP_Prem_Medium = 0, and Positive_TAPP_Prem_Large = 0; HIGH_Prem_Small = 10%, HIGH_Prem_Medium = 5%, and HIGH_Prem_Large = 0. Given the

coefficients in Column (5), the assessed increase in offer premium attributed to the loss relative to TAPP is 0.471 × 10% = 4.71%, while the assessed increase in offer premium due to the loss relative to the 52-week high is 0.535 × 10% + 0.140 × 5% = 6.05%. Thus, in our example, the total increase in offer premium due to losses relative to reference prices, 10.76%, is definitely economically significant.

Figure 2 plots the extra premium offered for various levels of losses relative to our two reference prices. Several observations are noteworthy. First, the compensation offered for a loss of Y% relative to the TAPP (TAPP_Prem line) is almost identical to the compensation offered for an equal loss relative to the 52-week high (High_Prem line). It appears that the bidder perceives both losses to be of equal importance for target shareholders, and offers an identical schedule of compensation for each of them.

[Insert Figure 2 about here]

Second, the extra premium exhibits diminishing marginal compensation for losses, consistent with our analysis of Table 3 and Table 5 results. However, Figure 2 demonstrates the magnitude of the phenomenon. For example, for a loss of 10% relative to the 52-week high, the extra premium offered is 5.4%, while for a five-fold loss of 50% relative to the 52-week high, the total extra premium offered is less than double, 9.2%. The higher marginal compensation for small losses is consistent with Prospect Theory and its S-shaped utility function of economic agents (target shareholders in our case). It might also indicate that there is a limit to the generosity of the bidder and her willingness to compensate target shareholders for their losses. Thus, it is possible that both sides of the deal are responsible for the diminishing marginal compensation phenomenon.

Third, it is interesting that the sum of the coefficients of Positive_TAPP_Prem_Small, 0.471, and HIGH_Prem_Small, 0.535, is very close to 1. The implication is that if target

shareholders' are in a 10% loss relative to our estimate of their purchase price (TAPP) and in a 10% loss relative to the 52-week high, they are offered an extra merger premium of about 10%. In such a case we can argue that they receive full compensation for their losses. In short, it can be argued that sometimes the bidder fully compensates target shareholders for small losses relative to their two pertinent reference prices, purchase price and 52-week high.

Last, the magnitude of the extra premium offered in response to losses relative to the reference prices is nontrivial. If the mean merger offer premium is about 32% (see Table 2), an extra premium for perceived losses of 10% (like in the example above) constitutes a nontrivial fraction of it. In the next section we examine how important are reference prices in determining the merger offer acceptance likelihood.

6. Reference Price Effects on Offer Acceptance Likelihood

Baker et al. (2012) proposed a methodology to test the effect of a reference price on merger offer "success" (= acceptance) likelihood (see their Table 7). We follow their specification and use as explanatory variables: 1) a quartic polynomial of the offer premium (to account for any possible effect of the offer premium on target shareholder accept/reject decisions), and 2) a dummy variable that equals 1 in cases where the offer price exceeds the reference price (to measure the behavioral effect of a reference price). According to Baker et al. (2012), if a reference price is cardinal in target shareholders' decisions, surpassing it creates a discontinuity or jump in offer acceptance likelihood. This possible upward jump is measured by the dummy variable coefficient in the above-suggested specification.

Table 7 presents the results of Probit analyses of offer acceptances including discontinuity dummies for our two reference prices. We employ a full suite of controls including deal controls,

target- and bidder-firm controls, and industry- and fiscal year-fixed effects. Columns (1) and (2) report the benchmark Probit analysis without the presence of any reference prices. From Column (2), the parsimonious form of the Probit results, we can infer on some factors (apart from the offer premium) that affect offer acceptance likelihood. It appears that relatively large targets that demonstrate relatively high-sales growth rates reject merger offers more often. On the other hand, offers of large and highly valued bidders are more likely to be accepted. Thus, offer acceptance likelihood appears to depend on the relative size and relative "success" of the bidder and target.

Deal characteristics also have a nontrivial impact on offer acceptance likelihood. Friendly offers are more likely to be accepted, while diversifying offers proposing to combine firms from different industries are less convincing and more often rejected. In addition, rivalry between several bidders for the firm naturally reduces any offer success likelihood.

[Insert Table 7 about here]

Column (3) adds Bidder_High_Prem, the premium of bidder stock's 52-week high price over the bidder stock's pre-offer level, as an explanatory variable. The Bidder_High_Prem effect on offer acceptance likelihood is negative and statistically significant. Consistent with Ma et al.'s (2019) evidence on offer success in public firms (see their Table 8, specifically the last set of tests), the closer the bidder pre-offer price is to its 52-week high price (i.e., the lower is our Bidder_High_Prem) the more likely an offer acceptance becomes. Perhaps when the bidder's pre-offer price is close to its peak, public shareholders are somewhat enthusiastic about the bidder firm, and target shareholders are less inimical towards merging with it, increasing offer acceptance likelihood. It is noteworthy that when we add the interaction of a cash deal with Bidder_High_Prem to the Probit analysis, its coefficient is statistically insignificant. Thus, the effect of the bidder stock's 52-week high is not limited to deals wherein consideration is offered

in shares—i.e., the 52-week effect on offer acceptance likelihood is also present in cash deals in which bidder stock pricing is not a cardinal economic issue.

In Column (4), we add Dum_High to estimate the effect of the offer price exceeding the 52-week High price of target stock (specifically, Dum_High equals 1 when offer price ≥ target's 52-week high price, and equals 0 otherwise). The coefficient of Dum_High is positive and statistically significant at the 1% level. Evidently, when the offer price exceeds the 52-week high price of the target stock, offer success likelihood increases significantly. Given the point estimate of the Dum_High coefficient, we assess a 3.8% jump in acceptance probability when the offer price exceeds the target stock's 52-week high.

Column (5) adds Dum_TAPP to the Column (3) Probit. The effect of offer price exceeding the TAPP on offer acceptance likelihood is positive and significant at the 10% level. However, this effect is modest relative to the effect of Dum_High documented above. Apparently, the increase in acceptance likelihood upon surpassing the purchase price reference price is smaller than the jump in acceptance probability when the offer price exceeds target's 52-week high.

The impression that the effect of Dum_High on offer acceptance likelihood is stronger than the effect of Dum_TAPP receives support from the Probit analysis of Column (6) where we toss together these dummy variables. In Column (6) only the coefficient of Dum_High is statistically significant. The coefficient of Dum_TAPP is positive yet minute and statistically insignificant. Furthermore, the Probit R^2 in Column (6) is identical to that of Column (4) in which we employ only Dum_High. This finding suggests that only when offer price exceeds target's 52-week high we can reliably identify an upward jump in offer acceptance likelihood.

On reflection, the most important evidence in Table 7 may be the meagre improvement in explanatory power when we add the reference price effects. The Probit analysis Pseudo R^2

increases from 0.372 in a model without any behavioral effects, summarized in Column (2), to 0.379 in a model with behavioral effects, summarized in Column (4). This pale improvement in explanatory power appears to provide only weak support to our Hypothesis 4 that proposes a significant effect of reference prices on acceptance likelihood.

To further investigate the impact of reference prices on offer acceptance likelihood, we test the predictive ability of the Probit model with reference price effects in Column (4) and compare it to the predictive ability of the Probit model without reference price effects in Column (2). We define the prediction of the model to be "accept offer" for a specific offer, if for that offer the Probit model estimates translate into an imputed (calculated) offer-success probability equal or greater than one-half (i.e. fitted probability>50%). In essence, for each of the merger offers examined in Table 7 we generate an "accept" or "reject" prediction based on the non-behavioral Column (2) model and an "accept" or "reject" prediction based on the behavioral Column (4) model.

Table 8 compares the accept/reject predictions of these two models to the actual outcome of the merger offers—i.e., to whether the offer was eventually accepted. Panel A examines the Probit model without any reference prices. The model predicts the correct outcome in 3,129 out of 3,432 merger offers (91.17%). This high predictive ability is not surprising since the offer acceptance rate is 86.86% (2,981 out of 3,432 offers were accepted), hence a simple predictive model stating that a merger offer is always accepted would score a predictive ability of 86.86% in our test sample.

Panel B examines the predictive performance of the Probit model with reference prices. It predicts the correct outcome in 91.23% of the cases (3,131 out of the 3,432 offers in our test sample). The increase in predictive ability relative to the model without reference prices is minute.

In fact, the added variables in the model that includes reference prices, change the predictions of the model without reference prices in only 4 cases—i.e., in about 0.1% of our test sample 3,432 offers. Furthermore, in one of these four cases, the change of prediction made it wrong.

[Insert Table 8 about here]

The evidence in Tables 7 and 8—that behavioral reference prices have a negligible marginal effect on offer acceptance likelihood—does not imply that reference prices do not impact merger decisions. Recall that the Probit analysis of offer acceptance likelihood controls for the effect of the offer premium. Our evidence in Tables 3–6 shows that reference prices affect the offer premium significantly, and in a pattern that is consistent with prospect theory. Thus, the proper conclusion from our findings is that behavioral reference prices affect merger offers acceptance likelihood via their effect on the offer premium. Practically, once offer premium is adjusted to reference prices, no further behavioral effects need to be considered.

7. Reference Prices and Market's Response to the Merger Announcement

Our Hypothesis 4 proposes that the extra premium offered to target shareholders in cases where they are in loss relative to their average purchase price or in "loss" relative to the 52-week high price, promotes (diminishes) the target (acquirer) shareholders' return upon offer announcement. (Note that target shareholders are always in a loss relative to the 52-week high.)

We estimate acquirer and target stock response to the merger offer announcement, using two benchmark models: 1) the market model with the CRSP value-weighted market index, and 2) the Fama-French 5-factors model with factor returns data downloaded from Ken French's web site (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). For both models, the

parameter estimation period spans days A-250 through A-21, where day A is the merger announcement day.

Consistent with previous studies of mergers, the target stocks in our sample manifest a jump on offer announcement date while acquirer stocks usually plunge on that day. Thus, as customary, we approximate the offer announcement stock response by CAR(-1,1), the three days (day A-1 through A+1) cumulative abnormal return of the stock – see Betton et al. (2008)'s review. We compute CAR(-1,1) as the average of individual stocks' $CAR_i(-1,1)$, where $CAR_i(-1,1) = \prod_{T=-1}^{T=1}(1 + AR_{i,T})$, $AR_{i,T}$ is the abnormal return of stock i on day T, and day 0 is offer announcement date. For robustness checks we also compute CAR (-5,5). Also important, we exclude failed merger offers because for these offers the low success probability might have been evident from the start, i.e. the response to these offers might not be representative.

Table 9 presents the results. Panel A documents that target shareholders experience on average large positive revaluations (CARs) on merger announcement. Further, these announcement gains are significantly higher when target shareholders are in loss relative to their average purchase price TAPP, or are in greater "loss" relative to the 52-week high. For example, when target shareholders are in loss relative to TAPP, their average abnormal return on merger announcement is about 32%, much higher than the 19% mean abnormal return of targets that are in gain relative to TAPP. Notably, the CAR estimates of the Fama-French 5 factor methodology and the market model methodology are very similar, probably due to the large offer announcement date revaluation of the target stock. The extended 11-day CAR, CAR(-5,5) also manifests little differences relative to our main revaluation estimate, CAR(-1,1). It appears that pre-announcement losses of target shareholders relative to our two reference prices amplify target stock's positive response to the merger offer announcement.

The acquirer CAR statistics are summarized in Panel B. Acquirer sample size is smaller because some acquirers are foreign and some are not covered by CRSP. We find that acquirer shareholders lose on average on merger offer announcement, and that these losses are significantly higher when target shareholders are in loss relative to TAPP or in a relatively large loss relative to the 52-week high. The higher premiums paid to target shareholders as compensation for their losses relative to our two reference prices, significantly hurt acquirer shareholders. The mean CAR(-1,1) when extra premiums are paid (TAPP is higher than target's pre-offer stock price) is approximately -1.6%, significantly more negative than the mean response of approximately -0.9% documented for cases where no extra premium is needed (TAPP is lower than target's pre-offer price). Similar evidence is obtained when below and above median "losses" relative to the target 52-week high price are compared. Larger losses relative to the 52-week high are associated with deeper acquirer shareholders' losses on offer announcement.

[Insert Table 9 about here]

The CAR results in Panels A and B are consistent with previous evidence on samples of public bidders and targets like ours. For public firm mergers existing literature records negative (positive) acquirer (target) CARs – see Betton et al. (2008) and de Bodt et al. (2018). Nonetheless, our mean acquirer loss, CAR(-1,1) of -1.2%, may leave an impression of a relatively mild and perhaps economically insignificant acquirer loss. We estimate the total dollar loss of acquirer shareholders by multiplying their holdings' value on day A-21 (stock price times number of shares) by CAR(-1,1). Based on the market model CAR estimates, the mean total loss of acquirer shareholders is approximately 110 million dollars per merger, non-trivial. We also compute the corresponding target shareholders' total dollar gain in these cases (i.e., we limit the target sample to the merger offers for which we have acquirer CARs), and find a mean target shareholders' gain

of 195 million dollars per merger. This target shareholders' gain is significantly larger in absolute value than the acquirer shareholders' loss. Thus, according to our evidence, merger deals are economically efficient, as they increase target and acquirer combined market value by 85 million dollars per merger on average.

The evidence in Panels A and B tends to support Hypothesis 4 that the extra premium offered to target shareholders in compensation for their losses relative to TAPP and the 52-week high are at least partly overpayments that transfer wealth from acquirer- to target-shareholders. To further examine this hypothesis, we conduct a Two-Stage-Least-Squares analysis, similar to the one in Table 8 of Baker et al. (2012). Panel C presents our results. In the first stage we estimate the offer premium attributable to our two reference prices, and in the second stage we run a regression of CAR(-1,1) on the fitted offer premium and various control variables. As Baker et al. (2012) explain, this methodology cleans out the effect of synergy gains and leaves us with the effect of reference prices on announcement CARs.

Panel C reports that the fitted offer premium has a negative and significant effect of acquirer's CAR(-1,1) and a positive and significant effect on target's CAR(-1,1). The results are similar when CAR(-5,5) is employed (unreported results available from the authors). Thus, in sum, the more elaborate analysis of Panel C reinforces our conclusion that the extra premium paid for losses relative to reference prices is a behavioral phenomenon that tends to hurt acquirer shareholders and benefits target shareholders.

8. Summary and Conclusions

We test whether and how a measure of shareholders stock purchase price, TAPP, performs as a reference price in merger offers. In a large sample of all merger offers for U.S. public firms

in 1990-2019, where the bidder firm is also public, we find that the ratio of TAPP to the pre-offer target stock price impacts the merger offer premium significantly. Consistent with prospect theory, our evidence suggests that the offer premium increases when target shareholders are in loss (relative to their purchase price) on the eve of the offer, and that the marginal compensation for a loss decreases with the loss size. Thus, our measure appears to represent well the "mental accounting" considerations of target shareholders – their aversion to realize nominal losses.

In further tests we show that TAPP complements the effect of another reference price—the target stock's pre-offer 52-week high price (Baker et al., 2012). We show that both TAPP and the 52-week high significantly impact the merger offer premium. The premium adjustment for a loss relative to TAPP is about equal to the adjustment for a perceived loss relative to the 52-week high, and in some cases the extra premium offered to target shareholders fully compensates them for their losses relative to these reference prices. Apparently, both loss aversion (TAPP) and regrets (52-week high) impact merger offer premiums.

Interestingly, in our sample, TAPP dominates the effect of the institutional investors' average purchase price (Frazzini, 2006; and Ye, 2014), an indication that retail investors' purchase price is also taken into account when determining the offer premium. Nevertheless, we also provide some evidence suggesting that institutional investors' stance is more influential than retail investors' position during the merger premium determination.

We also find that when offer premium is used as an explanatory variable in the Probit of offer acceptance likelihood, reference prices have a negligible residual impact on target shareholders' decision to accept or reject an offer. This finding is confirmed by a simple test of predictive ability, comparing the number of correct predictions of models with and without reference prices. It appears that behavioral reference prices impact merger offers primarily (or

maybe even solely) via their effect on the merger premium. Once the premium is adjusted, all further reference price effects are immaterial.

The extra premium offered as compensation to target shareholders for losses relative to their purchase price and perceived losses relative to the 52-week high price, have significant valuation impacts. On average, acquirer stock declines and target stock increases following the reference-price-induced addition to the offer premium. It appears that acquirers could benefit from a milder consideration of target shareholders' reference prices.

Appendix A: Estimating the Average Purchase Price of All Shareholders

Suppose we have data on daily prices, volumes of trade and outstanding number of shares for a specific stock, and are interested in computing a measure of the average purchase price of its current (say day T) shareholders. The ideal estimate is a weighted average of past prices, where the weight of a particular past price (price on day t) approximates the proportion of current shareholders that bought the share at that price and held it till day T. An immediate plausible assumption is that the higher was the turnover (volume divided by outstanding shares) on a specific past date (day t), the higher is its weight. However, a second factor must be considered, as shareholders who purchased the stock further back in time (on day t=T- τ, where τ is large) are more likely to have sold it by day T. Therefore, an appropriate measure of current shareholders average purchase price should also discount more heavily prices that are further back in time.

Our method for discounting more heavily further-away prices is based on the Proportional Trading Model (PTM) frequently used by courts in class-action suits for assessing the damage caused by a security fraud. Furbush and Smith (1994) discussed this model and its application in litigation.

The PTM postulates that on trading day t, each existing shareholder of stock i sells a proportion $x_{i,t}$ of her holdings regardless of their longevity. Accordingly, $x_{i,t}$ can be estimated as the proportion of stock i's outstanding shares traded on day t, that is:

(A1) $$x_{i,t} = \frac{Number\ of\ shares\ of\ i\ traded\ on\ day\ t}{Total\ number\ of\ shares\ of\ i\ outstanding\ on\ day\ t} \quad .$$

We define the average purchase price of share i at time T as the weighted average of past share prices in which the share price on each trading day t in the past receives a weight according to the proportion of existing shareholders at time T that bought and held stock i since day t. For

example, if the total shares outstanding of stock i is constant at 1 million shares, 1,000 shares were bought on day t, yet 600 of these shares were sold by day T, then $\alpha_{i,t}^{T}$, the proportion of outstanding shares of i at time T purchased on day t in the past is: (1000-600)/1,000,000 = 0.0004.

Returning to our specific problem of estimating the average target stock purchase price at the merger offer date, suppose we are at market close on the day of an offer (day T) and wish to assess the series of $\alpha_{i,t}^{T}{}'s$, the proportion of outstanding shares of i at time T (offer date) purchased on day t in the past. First, according to Eq. (A1), the proportion of outstanding shares at the end of day T purchased during day T is:

(A2) $\alpha_{i,T}^{T} = \mathrm{x}_{i,T}$.

For example, if 0.5% of the outstanding shares were traded on day T, then, at the end of day T, 0.5% of the shares were purchased at the day T price. Progressing backwards to day T-1,

(A3) $\alpha_{i,T-1}^{T} = \mathrm{x}_{i,T-1} \cdot (1 - \mathrm{x}_{i,T})$.

To demonstrate, if 0.6% (0.006) of outstanding shares were traded on day T-1, 99.5% of them were still held on day T close (0.5% were sold on day T; see above). Thus, among all shareholders of i on day T close, the fraction of shares bought on day T-1 is 0.006 times 0.995 = 0.000597. More generally,

(A4) $\alpha_{i,t}^{T} = \mathrm{x}_{i,t} \cdot \prod_{k=t+1}^{T}(1 - \mathrm{x}_{i,k})$.

Given the series of α's, the average purchase price of the shares of stock i held at the end of day T, $\mathrm{TAPP}_{i,T}$, can be calculated as the following weighted average:

(A5) $\mathrm{TAPP}_{i,T} = \sum_{t=2}^{T} \alpha_{i,t}^{T} \cdot P_{i,t} + \left(1 - \sum_{t=2}^{T} \alpha_{i,t}^{T}\right) \cdot P_{i,1}$,

where t is a counter of stock i's day of trade on the exchange, t = 1 is the stock's first day of trade on the exchange, and $P_{i,t}$ is the price of stock i on the exchange on day t. In Eq. (A5), each trading-

day price is weighted according to its α, which is its share in shareholding at the focal day T (the merger offer date in our case). The remaining weight, unaccounted by the sum of α's, is then attributed to the price of stock i on its first day of trade on the exchange.

In retrospective, TAPP accomplishes our initial conditions for an adequate purchase price estimator. By its definition in Eq. (A4), the weight α assigned to a particular past price considers both the daily turnover on that past day, $x_{i,t}$, and the attrition over time in veteran investor holdings (the fact that they might have sold the shares by our focal time T). This attrition in holdings is accounted for by setting a diminishing weight to earlier prices, the $\prod_{k=t+1}^{T}(1 - x_{i,k})$ factor in Eq. (A4), where the discount on an early date (say day t) price depends on the trading activity or turnover in the stock during the period between day t and day T. By Eq. (A4), the higher is the turnover in the stock, the more heavily are past prices discounted, i.e., the lower is the weight of the price on a particular day t in the past. This discounting method appears to us plausible, hence TAPP, as defined in Eq. (A5), appears as a legitimate purchasing price estimator.

In practice, our calculations employ several simplifying assumptions. For example, in Eq. (A5), we should have used the IPO price for the remaining weight $(1-\sum\alpha_{i,t})$.[8] We instead use the stock price on its first day of trade on the exchange. However, the error created by this deviation is relatively small, as most stocks are veterans on the exchange, hence the weight assigned to the first day of trade is typically minute. Another practical deviation is that although we correct prices for splits, we ignore cash dividends and other distributions that may affect the shareholders' perceived purchase price.

[8] If IPO price is known, the following formula is appropriate: $TAPP_{i,T} = \sum_{t=1}^{T} \alpha_{i,t}^{T} \cdot P_{i,t} + \left(1 - \sum_{t=1}^{T} \alpha_{i,t}^{T}\right) \cdot P_{i,0}$, where $P_{i,0}$ is the IPO price, and $P_{i,1}$ is the stock i closing price on its first day of trade on the exchange.

Appendix B: The Average Purchase Price of Institutional Investors

Frazzini (2006) developed the Institutional Investors Average Purchase Price (IIAPP, in short). Institutional investors are required to report their equity holding information on a quarterly basis. These data are available on SEC Form 13F (s34 files on WRDS). Frazzini (2006) assessed the number of shares of stock i purchased or sold by institutional investor Y during quarter t by computing the difference in the number of i shares held by institutional investor Y between the end of quarter t and the end of quarter t-1. Stock i's price at the report date (end of the quarter) is used as a proxy for the institutional investor's purchase price. For each stock-institutional investor combination, Frazzini generated a queue of all purchases and sales over time. Holdings that were purchased first are assumed to be sold first (a First-In-First-Out inventory system). This process affords assessing the purchase date and price of each share of stock i held by each institutional investor at the end of each quarter. Next, we compute for each institutional investor the weighted purchase price for the inventory of shares of stock i held by this institutional investor at the end of the quarter preceding the merger announcement date:

(B1) $\mathrm{APP}_{Y,i,T} = \sum_{t=0}^{T} \alpha_{Y,i,t}^{T} \cdot P_{i,t}$,

where $\mathrm{APP}_{Y,i,T}$ is the average purchase price of the i shares held by institutional investor Y at time T (end of the quarter preceding the merger offer date), $\alpha_{Y,i,t}^{T}$ is the proportion of institutional investor Y's holdings of stock i at time T that was purchased in quarter t in the past,[9] and $P_{i,t}$ is the price of stock i on the exchange at the end of quarter t. For example, if institutional investor Y's current inventory consists of 500 shares bought in quarter T-2 and 250 shares bought in quarter

[9] $\alpha_{Y,i,t}^{T}$ is computed based on the inventory book of institutional investor Y as $N_{Y,i,t}^{T}/N_{Y,i}^{T}$, where $N_{Y,i,t}^{T}$ is the number of shares of i that were bought by institutional investor Y on quarter t and held till end of quarter T, and $N_{Y,i}^{T}$ is the total number of shares of i held by institutional investor Y at the end of quarter T.

T-1, Eq. (6) tells us that the average purchase price by institutional investor Y is two-thirds of the stock price at the end of quarter T-2 plus one-third of the stock price at the end of quarter T-1.

Last, following Ye (2014), we estimate the IIAPP as a weighted average of all institutional investors' purchase prices. The weight assigned to institutional investor Y's purchase price is its proportion of the total institutional investors' holdings of stock i at the end of the quarter preceding the merger announcement date. The resulting estimate is as follows:

(B2) $\text{IIAPP}_{i,T} = \sum_{Y=1}^{N} w_{Y,i,t}^{T} \cdot APP_{Y,i,T}$,

where $\text{IIAPP}_{i,T}$ is institutional investors' (weighted) average purchase price of stock i shares as of time T, $\text{APP}_{Y,i,T}$ is the corresponding average purchase price of institutional investor Y, $w_{Y,i,t}^{T}$ is the proportion of institutional investor Y in the total institutional investors holdings at time T, and N is the number of institutional investors holding stock i.

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Table 1: Sample Descriptive Statistics

The table describes our sample of 4,910 merger offers for U.S. public firms from 1990 to 2019. Target and bidder characteristics are computed using Compustat utilizing data for the fiscal year preceding the offer. Return on assets is income before extraordinary items (IB) divided by total assets (AT); sales growth rate is the rate of sales growth over the prior fiscal year; leverage is long-term debt total (DLTT) divided by total assets (AT); market-to-book ratio is market equity, computed by multiplying common shares outstanding and price at fiscal year-end (PRCC_F*CSHO), divided by common/ordinary shareholders' equity at fiscal year-end (CEQ); price-earnings ratio is the ratio of year-end stock price (PRCC_F) to earnings per share for that year (EPSPX). All characteristics are winsorized at the 2.5% and 97.5% levels. The merger offer characteristics: form of payment (all-cash, all-stock), bidder attitude (friendly), existence of rival bids (offers with more than one bidder), diversifying offers (the bidder and target have different 2-digit Standard Industrial Classification codes), and deal completion indicator, are from the SDC file (Thomson Reuters).

	Number of observations	Mean or proportion	Median	Standard deviation
Target firm characteristics				
Total assets (in million dollars)	4,832	1,322.99	300.85	2,805.74
Sales growth rate	4,713	0.1996	0.0995	0.4210
Return on assets	4,832	-0.0289	0.0121	0.1728
Debt divided by total assets	4,803	0.1565	0.0788	0.1826
Market-to-book ratio of the stock	4,808	2.4993	1.7302	2.3795
Price-earnings ratio of the stock	4,814	11.13	12.50	31.86
Bidder firm characteristics				
Total assets (in million dollars)	3,816	12,761.28	2,432.28	26,488.70
Sales growth rate	3,739	0.2498	0.1285	0.4408
Return on assets	3,811	0.0283	0.0313	0.0917
Debt divided by total assets	3,798	0.1615	0.1137	0.1601
Market-to-book ratio of the stock	3,755	3.4064	2.3145	3.0745
Price-earnings ratio of the stock	3,747	19.1018	16.7079	32.2015
Bidder experience (number of previous bids)	4,303	1.46	0	2.75
Merger offer characteristics				
Proportion of completed deals	4,910	0.8668		
Proportion of diversifying offers	4,910	0.3275		
Proportion of rival bids	4,910	0.0725		
Proportion of "all cash" offers	4,910	0.3613		
Proportion of "all stock" offers	4,910	0.3452		
Proportion of "friendly" offers	4,910	0.9385		

Table 2: Various Price Ratios on the Eve of Merger Offer

This table documents the mean and median of some potentially relevant price ratios on the eve of merger offers, including a partition by deal completion. The sample includes 4,910 merger offers for U.S. public firms from 1990 to 2019. TAPP is the average purchase price measure we develop; IIAPP is the institutional investors' average purchase price; AVG_PP is a simple average of all past stock prices; WAVG_PP is a turnover-weighted average of all past stock prices; TAPP_75 (TAPP_87.5) is a TAPP-style measure with daily turnover multiplied by 0.75 (0.875) (more details in the text); and the price on day A-21 is the price 21 trading days (about a month) before the offer announcement. Winsorizing is performed on each of the ratios at the 2.5% and 97.5% levels. The last column reports the difference in the mean price ratio between completed and failed deals, as well as its statistical significance (derived from a two-sided t-test of mean differences). ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Price ratio	Number of obs.	Mean (median) for all offers	Mean (median) for completed deals	Mean (median) for failed offers	Difference in means between completed and failed offers
Ln (offer price / target stock price on day A-21)	4,910	0.316 (0.293)	0.318 (0.294)	0.302 (0.285)	0.016
Ln (TAPP / target stock price on day A-21)	4,910	0.052 (-0.028)	0.040 (-0.037)	0.126 (0.042)	-0.086***
Ln (AVG_PP / target stock price on day A-21)	4,910	0.013 (-0.119)	-0.001 (-0.136)	0.105 (-0.035)	-0.106***
Ln (WAVG_PP / target stock price on day A-21)	4,910	0.101 (-0.082)	0.083 (-0.095)	0.220 (0.046)	-0.137***
Ln (TAPP_75 / target stock price on day A-21)	4,910	0.066 (-0.033)	0.051 (-0.045)	0.158 (0.054)	-0.107***
Ln (TAPP_87.5 / target stock price on day A-21)	4,910	0.058 (-0.031)	0.045 (-0.041)	0.142 (0.048)	-0.097***
Ln (target's IIAPP / target stock price on day A-21)	4,795	0.084 (-0.024)	0.070 (-0.035)	0.179 (0.056)	-0.109***
Ln (target's pre-offer 52-week high price / target stock price on day A-21).	4,910	0.338 (0.193)	0.329 (0.186)	0.401 (0.257)	-0.072***
Ln (bidder's pre-offer 52-week high price / bidder's stock price on day A-21)	4,130	0.194 (0.111)	0.185 (0.103)	0.257 (0.173)	-0.072***

Table 3: Reference Price Effects on the Merger Offer Premium

The table reports results of OLS regressions seeking to explain the merger offer premiums (Offer_Prem). The offer premium is defined as Ln(offer price/stock price A-21) in which stock price A-21 is the target stock price 21 trading days (about a month) before the offer announcement date. Regarding reference price-explanatory variables, HIGH_Prem measures the impact of the 52-week-high price, and is defined as Ln(the pre-offer, 52-week-high price/stock price A-21); and TAPP_Prem measures the impact of TAPP (target shareholders average purchase rice) and is defined as Ln(TAPP/stock price A-21). Columns (4), (6) and (8) report the results of piecewise regressions estimating the marginal effects of the size of the reference price premium. For example, TAPP_Prem is divided into three loss regions: small, medium, and large losses on the offer eve (relative to TAPP) and three gain regions with a separate marginal coefficient estimated for each of these six regions. (More details in the text.)

All merger deal characteristics are from the SDC: Friendly is a dummy variable equal to 1 if the deal attitude is friendly and equal to 0 if not; All_Cash is a dummy variable equal to 1 if the deal consideration structure is cash only and equal to 0 if not; All_Stock is a dummy variable equal to 1 if the deal consideration structure is shares only and equal to 0 if not; Diversified is a dummy variable equal to 1 if the bidder and target are from different industries (as defined by their 2-digit Standard Industrial Classification codes) and equal to 0 if not; Rival_Bid is a dummy variable equal to 1 if a target has more than one bidder at the time of the offer and equal to 0 if not. Target firm characteristics employed as explanatory variables include: Target_Size is the natural logarithm of the firm's total assets (in millions of U.S. dollars) at the end of the fiscal year preceding the offer; Sales_Growth is the rate of sales growth over the prior fiscal year; DA is the ratio of long-term debt to total assets at the end of the fiscal year preceding the offer; ROA is a ratio of income before extraordinary items to total assets at the end of the fiscal year preceding the offer; MB is the ratio of year-end market value of common stock to the book value of equity for the prior fiscal year; PE is the ratio of year-end stock price to earnings per share for the prior fiscal year. All continuous variables are winsorized at the 2.5% and 97.5% levels, and all specifications include calendar year and industry fixed effects (using the Fama-French 48 industry classification). Robust standard errors, clustered at the target firm level, are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 3 (cont.)

	(1)	(2)	(3)	(4)	(5)	(6)
Friendly	-0.0172	-0.0224*	-0.0217*	-0.0179	-0.0223*	-0.0198
	(0.0135)	(0.0128)	(0.0123)	(0.0121)	(0.0122)	(0.0122)
All_Cash	0.0386***	0.0375***	0.0427***	0.0424***	0.0409***	0.0409***
	(0.00854)	(0.00839)	(0.00810)	(0.00803)	(0.00813)	(0.00809)
All_Stock	-0.0309***	-0.0334***	-0.0384***	-0.0377***	-0.0440***	-0.0436***
	(0.00886)	(0.00872)	(0.00858)	(0.00852)	(0.00857)	(0.00851)
Diversified	0.00567					
	(0.00755)					
Rival_Bid	0.00345					
	(0.0150)					
Sales_Growth	-0.00656					
	(0.00982)					
DA	0.0295					
	(0.0233)					
ROA	-0.0111					
	(0.0298)					
MB	-0.00397**	-0.00357**	-0.0000674			
	(0.00171)	(0.00161)	(0.00158)			
PE	-0.000129					
	(0.000109)					
Target_Size	-0.0160***	-0.0163***	-0.00950***	-0.00998***	-0.0108***	-0.00997***
	(0.00236)	(0.00226)	(0.00220)	(0.00224)	(0.00223)	(0.00222)
TAPP_Prem			0.142***			
			(0.0125)			
Positive_TAPP_Prem_Large				0.0403		
				(0.0346)		
Positive_TAPP_Prem_Medium				0.138*		
				(0.0737)		
Positive_TAPP_Prem_Small				0.416***		
				(0.119)		
Negative_TAPP_Prem_Small				0.246**		
				(0.117)		
Negative_TAPP_Prem_Medium				0.235**		
				(0.0995)		
Negative_TAPP_Prem_Large				0.0811		
				(0.0531)		
HIGH_Prem					0.128***	
					(0.0125)	
HIGH_Prem_Large						0.0611***
						(0.0196)
HIGH_Prem_Medium						0.271***
						(0.0439)
HIGH_Prem_Small						0.642***
						(0.0985)
Industry and year fixed effects	YES	YES	YES	YES	YES	YES
Observations	4647	4808	4808	4832	4832	4832
Adjusted R^2	0.096	0.096	0.137	0.146	0.130	0.143

Table 4: The Explanatory Power of Alternative Measures of the Average Purchase Price

The table examines the impact of alternative average purchase price measures on the merger offer premium. Each of the measures is added separately to our piecewise regression model of the offer premium. The dependent variable is the merger offer premium, defined as Ln(offer price/stock price A-21), in which stock price A-21 is the target stock price 21 trading days (about a month) before the offer announcement date. The focal explanatory variable, Ln(average purchase price measure/stock price A-21), is divided into three loss (= Positive_APP_Prem) regions: small, medium, and large losses on the offer eve, and three gain (= Negative_APP_Prem) regions, with a separate marginal coefficient estimated for each of these six regions. (More details in the text.) In Panel A we consider six alternative average purchase price measures: 1) AVG_PP - the average target stock adjusted price from its first day of trade on the exchange until day A-21; 2) WAVG_PP - the turnover weighted average stock adjusted price from its first day of trade on the exchange until day A-21; 3) IIAPP – the institutional investor average purchase price; 4) TAPP – the average purchase price estimate we develop in this study; 5) TAPP_75 – a TAPP-style measure with daily turnover multiplied by 0.75; and 6) TAPP_87.5 – a TAPP-style measure with daily turnover multiplied by 0.875. In Panel B we add the retail investors' average purchase price to the analysis. Retail_APP is computed by assuming that TAPP is a weighted average of IIAPP and Retail_APP. Unreported deal and firm controls include Friendly (a dummy variable equal to 1 if the deal attitude is friendly and equal to 0 if not); All_Cash (a dummy variable equal to 1 if the deal consideration structure is cash only and equal to 0 if not); All_Stock (a dummy variable equal to 1 if the deal consideration structure is shares only and equal to 0 if not; and Target_Size (the natural logarithm of the firm's total assets (at the end of the fiscal year preceding the offer). All continuous variables are winsorized at the 2.5% and 97.5% levels, and all specifications include calendar year and industry fixed effects (using the Fama-French 48 industry classification). Robust standard errors, clustered at the target firm level, are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Panel A: TAPP versus five other average purchase price estimators

	Average purchase price measure used for explaining the offer premium					
	AVG_PP	**WAVG_PP**	**IIAPP**	**TAPP**	**TAPP_75**	**TAPP_87.5**
Deal and firm controls	YES	YES	YES	YES	YES	YES
Positive_APP_Prem_Large	0.00210	0.00627	0.0272	0.0403	0.0258	0.0325
	(0.0197)	(0.0174)	(0.0229)	(0.0346)	(0.0283)	(0.0315)
Positive_APP_Prem_Medium	0.0789**	0.0647*	0.0684	0.138*	0.109*	0.119*
	(0.0381)	(0.0350)	(0.0514)	(0.0737)	(0.0588)	(0.0631)
Positive_APP_Prem_Small	0.100*	0.0735	0.344***	0.416***	0.354***	0.370***
	(0.0589)	(0.0502)	(0.0994)	(0.119)	(0.101)	(0.107)
Negative_APP_Prem_Small	0.0882*	0.126**	0.148	0.246**	0.172*	0.239**
	(0.0472)	(0.0508)	(0.0904)	(0.117)	(0.0956)	(0.104)
Negative_APP_Prem_Medium	0.0476	0.0385	0.110*	0.235**	0.252***	0.226***
	(0.0367)	(0.0427)	(0.0620)	(0.0995)	(0.0807)	(0.0836)
Negative_APP_Prem_Large	0.00202	0.0204	0.0384	0.0811	0.00985	0.0267
	(0.0233)	(0.0288)	(0.0382)	(0.0531)	(0.0433)	(0.0457)
Industry and year fixed effects	YES	YES	YES	YES	YES	YES
Observations	4832	4832	4729	4832	4832	4832
Adjusted R^2	0.118	0.118	0.136	0.146	0.143	0.144

Panel B: The explanatory power of retail investors' average purchase price

	Average purchase price measure used for explaining the offer premium					
	TAPP	**IIAPP**	**RETAIL**	**RETAIL+ IIAPP**	**RETAIL+ IIAPP (INST._LOW)**	**RETAIL+ IIAPP (INST._HIGH)**
Deal and firm controls	YES	YES	YES	YES	YES	YES
Positive_APP_Prem_Large	0.0491	0.0336	-0.0192			
	(0.0353)	(0.0232)	(0.0142)			
Positive_APP_Prem_Medium	0.144*	0.0582	0.0460			
	(0.0759)	(0.0527)	(0.0470)			
Positive_APP_Prem_Small	0.387***	0.345***	0.222***			
	(0.126)	(0.103)	(0.0847)			
Negative_APP_Prem_Small	0.259**	0.150	0.139			
	(0.125)	(0.0941)	(0.0963)			
Negative_APP_Prem_Medium	0.248**	0.134**	0.112*			
	(0.104)	(0.0648)	(0.0667)			
Negative_APP_Prem_Large	0.0775	0.0256	-0.0133			
	(0.0548)	(0.0393)	(0.0293)			
Positive_Retail_Prem_Large				0.00202	0.0197	0.00765
				(0.0145)	(0.0406)	(0.0137)
Positive_Retail_Prem_Medium				0.00640	0.0365	0.0213
				(0.0479)	(0.0827)	(0.0554)
Positive_Retail_Prem_Small				0.158*	0.263**	0.0758
				(0.0837)	(0.131)	(0.107)
Negative_Retail_Prem_Small				0.0563	0.114	0.0618
				(0.0957)	(0.149)	(0.124)
Negative_Retail_Prem_Medium				0.0603	-0.0240	0.171*
				(0.0661)	(0.103)	(0.0923)
Negative_Retail_Prem_Large				0.0625**	0.131*	0.0535
				(0.0295)	(0.0669)	(0.0330)
Positive_IIAPP_Prem_Large				0.0230	0.00593	0.0850*
				(0.0239)	(0.0334)	(0.0461)
Positive_IIAPP_Prem_Medium				0.0510	0.0110	0.0868
				(0.0533)	(0.0832)	(0.0719)
Positive_IIAPP_Prem_Small				0.322***	0.163	0.400***
				(0.103)	(0.168)	(0.130)
Negative_IIAPP_Prem_Small				0.138	0.253*	0.0417
				(0.0939)	(0.151)	(0.121)
Negative_IIAPP_Prem_Medium				0.135**	-0.0673	0.284***
				(0.0648)	(0.108)	(0.0824)
Negative_IIAPP_Prem_Large				0.0355	0.0720	0.0331
				(0.0407)	(0.0623)	(0.0518)
Industry and year fixed effects	YES	YES	YES	YES	YES	YES
Observations	4464	4464	4464	4464	2232	2232
Adjusted R^2	0.148	0.116	0.135	0.145	0.109	0.221

Table 5: The Combined Effect of Reference Prices on the Merger Offer Premium

The table reports the results of OLS regressions seeking to explain the merger offer premiums (Offer_Prem) and employs various combinations of reference prices. Offer premium is defined as Ln(offer price/stock price A-21) in which stock price A-21 is target stock price 21 trading days (about a month) before the offer announcement date. Regarding reference price explanatory variables, HIGH_Prem measures the impact of the 52-week high price, and is defined as Ln(the pre-offer 52-week-high price/stock price A-21); TAPP_Prem measures the impact of TAPP (target shareholders average purchase price), and is defined as Ln(TAPP/stock price A-21), and IIAPP_Prem measures the impact of IIAPP (institutional investors' average purchase price) and defined as Ln(IIAPP/stock price A-21). Columns (2) and (4) report the results of piecewise regressions estimating the marginal effect of the size of each reference price premium. For example, TAPP_Prem is divided into three loss regions: small, medium, and large losses on the offer eve (relative to TAPP) and three gain regions with a separate marginal coefficient estimated for each of these six regions. (More details in the text.).

Unreported deal and firm controls include Friendly (a dummy variable equal to 1 if the deal attitude is friendly and equal to 0 if not); All_Cash (a dummy variable equal to 1 if the deal consideration structure is cash only and equal to 0 if not); All_Stock (a dummy variable equal to 1 if the deal consideration structure is shares only and equal to 0 if not; and Target_Size (the natural logarithm of the firm's total assets (at the end of the fiscal year preceding the offer). All continuous variables are winsorized at the 2.5% and 97.5% levels, and all specifications include calendar year and industry fixed effects (using the Fama-French 48 industry classification). Robust standard errors, clustered at the target firm level, are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 5 (cont.)

	(1)	(2)	(3)	(4)
TAPP_Prem	0.108***		0.105***	
	(0.0179)		(0.0203)	
Positive_TAPP_Prem_Large		0.0345		0.0422
		(0.0381)		(0.0450)
Positive_TAPP_Prem_Medium		0.140*		0.142*
		(0.0768)		(0.0848)
Positive_TAPP_Prem_Small		0.338***		0.298**
		(0.126)		(0.128)
Negative_TAPP_Prem_Small		0.0877		0.0633
		(0.121)		(0.125)
Negative_TAPP_Prem_Medium		0.0645		0.0542
		(0.103)		(0.106)
Negative_TAPP_Prem_Large		0.0742		0.0560
		(0.0538)		(0.0565)
HIGH_Prem	0.0478***		0.0457**	
	(0.0178)		(0.0192)	
HIGH_Prem_Large		0.00792		0.00895
		(0.0246)		(0.0270)
HIGH_Prem_Medium		0.109**		0.0957*
		(0.0521)		(0.0534)
HIGH_Prem_Small		0.537***		0.534***
		(0.110)		(0.111)
IIAPP_Prem			0.00434	
			(0.0138)	
Positive_IIAPP_Prem_Large				-0.00486
				(0.0304)
Positive_IIAPP_Prem_Medium				-0.0287
				(0.0580)
Positive_IIAPP_Prem_Small				0.134
				(0.106)
Negative_IIAPP_Prem_Small				-0.0257
				(0.0926)
Negative_IIAPP_Prem_Medium				0.0177
				(0.0631)
Negative_IIAPP_Prem_Large				0.0288
				(0.0388)
Deal and firm explanatory variables	YES	YES	YES	YES
Industry and calendar fixed effects	YES	YES	YES	YES
Observations	4729	4729	4729	4729
Adjusted R^2	0.144	0.155	0.144	0.155

Table 6: Adding Bidder Characteristics to the Merger Offer Premium Analysis

The table reports the results of OLS regressions seeking to explain the merger offer premiums (Offer_Prem), employing reference prices and an expanded set of controls. Offer premium is defined as Ln(offer price/stock price A-21), where stock price A-21 is target stock price 21 trading days (about a month) before offer announcement date. Regarding reference price explanatory variables, HIGH_Prem measures the impact of the 52-week high price, and is defined as Ln(the pre-offer 52-week-high price/stock price A-21); and TAPP_Prem measures the impact of TAPP (target shareholders average purchase price), and is defined as Ln(TAPP/stock price A-21). The sample size shrinks by about a quarter relative to the analysis in Table 5 because of missing bidder information. (All bidders are public, yet some of them are foreign and some are not covered by CRSP or Compustat.) Column (5) report the results of piecewise regressions estimating the marginal effect of the size of the reference price premiums. For example, TAPP_Prem is divided into three loss regions: small, medium, and large losses on the offer eve (relative to TAPP) and three gain regions with a separate marginal coefficient estimated for each of these six regions. (More details in the text.).

Deal controls include: Friendly (a dummy variable equal to 1 if the deal attitude is friendly and equal to 0 if not); All_Cash (a dummy variable equal to 1 if the deal consideration structure is cash only and equal to 0 if not); All_Stock (a dummy variable equal to 1 if the deal consideration structure is shares only and equal to 0 if not. Based on Table 5 evidence, target firm controls include only Target_Size (the natural logarithm of the target firm's total assets (at the end of the fiscal year preceding the offer). Bidder controls include: Bidder_experience is bidder's number of previous mergers; Bidder ROA is a ratio of the bidder's income before extraordinary items to bidder's total assets at the end of the fiscal year preceding the offer; Bidder sales growth is the bidder's rate of sales growth over the prior fiscal year; Bidder DA is the bidder's ratio of long-term debt to total assets at the end of the fiscal year preceding the offer; Bidder MB is the ratio of bidder's year-end market value of common stock to the bidder's book value of equity in the prior fiscal year; Bidder PE is the ratio of year-end bidder's stock price to bidder's earnings per share for the prior fiscal year; Bidder size is the natural logarithm of the bidder firm's total assets at the end of the fiscal year preceding the offer; Bidder High_Prem is Ln(bidder's stock pre-offer 52-week high price/bidder's stock price A-21); Bidder_High_Prem_Cash is an interaction term between cash deals and Bidder_High_Prem. All continuous variables are winsorized at the 2.5% and 97.5% levels, and all specifications include calendar year and industry fixed effects (using the Fama-French 48 industry classification). Robust standard errors, clustered at the target firm level, are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Friendly	-0.0203	-0.0399***	-0.0416***	-0.0405***	-0.0389***
	(0.0143)	(0.0142)	(0.0142)	(0.0143)	(0.0142)
All_Cash	0.0466***	0.0183*	0.0172*	-0.00691	-0.00629
	(0.00938)	(0.00975)	(0.00970)	(0.0116)	(0.0115)
All_Stock	-0.0405***	-0.0394***	-0.0411***	-0.0403***	-0.0407***
	(0.00947)	(0.00935)	(0.00935)	(0.00935)	(0.00933)
Target size	-0.00822***	-0.0205***	-0.0214***	-0.0218***	-0.0204***
	(0.00257)	(0.00312)	(0.00312)	(0.00312)	(0.00319)

Table 6 (cont.)

Bidder_experience		-0.00206*	-0.00215*	-0.00219*	-0.00255**
		(0.00123)	(0.00123)	(0.00123)	(0.00122)
Bidder ROA		0.185***	0.170***	0.153**	0.120**
		(0.0622)	(0.0604)	(0.0609)	(0.0614)
Bidder sales growth		-0.00150			
		(0.0101)			
Bidder DA		-0.0539**	-0.0598**	-0.0600**	-0.0712***
		(0.0270)	(0.0270)	(0.0270)	(0.0271)
Bidder MB		0.00477***	0.00510***	0.00527***	0.00508***
		(0.00148)	(0.00146)	(0.00146)	(0.00146)
Bidder PE		0.0000145			
		(0.000133)			
Bidder size		0.0174***	0.0177***	0.0180***	0.0185***
		(0.00287)	(0.00284)	(0.00283)	(0.00283)
Bidder High_Prem		-0.101***	-0.104***	-0.140***	-0.146***
		(0.0244)	(0.0244)	(0.0288)	(0.0287)
Bidder_High_Prem_Cash				0.127***	0.125***
				(0.0438)	(0.0437)
TAPP_Prem	0.104***	0.134***	0.137***	0.135***	
	(0.0204)	(0.0202)	(0.0202)	(0.0203)	
HIGH_Prem	0.0500**	0.0700***	0.0660***	0.0695***	
	(0.0203)	(0.0204)	(0.0207)	(0.0208)	
HIGH_Prem_Large					0.0220
					(0.0284)
HIGH_Prem_Medium					0.140**
					(0.0593)
HIGH_Prem_Small					0.535***
					(0.122)
Positive_TAPP_Prem_Large					0.0779*
					(0.0424)
Positive_TAPP_Prem_Medium					0.156*
					(0.0882)
Positive_TAPP_Prem_Small					0.471***
					(0.140)
Negative_TAPP_Prem_Small					0.00825
					(0.136)
Negative_TAPP_Prem_Medium					0.0877
					(0.114)
Negative_TAPP_Prem_Large					0.0604
					(0.0570)
Industry and year fixed effects	YES	YES	YES	YES	YES
Observations	3547	3547	3587	3587	3587
Adjusted R^2	0.147	0.181	0.180	0.182	0.192

Table 7: The Effect of Reference Prices on the Offer Acceptance Likelihood

The table reports results of the Probit analyses. The dependent variable equals 1 if the merger is completed and 0 otherwise. The independent variables include: a quartic polynomial of the offer premium over the target stock price 21 days before the announcement day; Dum_High is a dummy variable equal to 1 if offer price > = the target highest price in the period from day -21 to day -250 preceding the offer (equals 0 otherwise); Dum_TAPP is a dummy variable based on our estimate of target shareholders average purchase price, and it equals 1 if offer price >= TAPP (equals 0 otherwise). Deal controls include: Friendly is a dummy variable equal to 1 if the deal attitude is friendly and equal to 0 if not; All_Cash is a dummy variable equal to 1 if the deal consideration structure is cash only and equal to 0 if not; All_Stock is a dummy variable equal to 1 if the deal consideration structure is shares only and equal to 0 if not; Diversified is a dummy variable equal to 1 if the bidder and target are from different industries (as defined by their 2-digit Standard Industrial Classification codes) and equal to 0 if not; Rival_Bid is a dummy variable equal to 1 if the target has more than one bidder at the time of the offer and equal to 0 if not. Target firm characteristics are also employed as explanatory variables: Target_Size is the natural logarithm of the firm's total assets (in millions of U.S. dollars) at the end of the fiscal year preceding the offer; Sales_Growth is the rate of sales growth over the prior fiscal year; DA is the ratio of long-term debt to total assets at the end of the fiscal year preceding the offer; ROA is a ratio of income before extraordinary items to total assets at the end of the fiscal year preceding the offer; MB is the ratio of year-end market value of common stock to the book value of equity for the prior fiscal year; and PE is the ratio of year-end stock price to earnings per share in the prior fiscal year. Bidder controls include: Bidder_experience is the number of bidder previous mergers; Bidder ROA is a ratio of the bidder's income before extraordinary items to the bidder's total assets at the end of the fiscal year preceding the offer; Bidder sales growth is the bidder's rate of sales growth over the prior fiscal year; Bidder DA is the bidder's ratio of long-term debt to total assets at the end of the fiscal year preceding the offer; Bidder MB is the ratio of the bidder's year-end market value of common stock to the bidder's book value of equity for the prior fiscal year; Bidder PE is the ratio of the year-end bidder's stock price to bidder's earnings per share for the prior fiscal year; Bidder size is the natural logarithm of the bidder firm's total assets at the end of the fiscal year preceding the offer; Bidder High_Prem is Ln(bidder's stock pre-offer 52-week high price/bidder's stock price A-21). All continuous variables are winsorized at the 2.5% and 97.5% levels, and all specifications include calendar year and industry fixed effects (using the Fama-French 48 industry classification). Robust standard errors, clustered at the target firm level, are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 7 (cont.)

	(1)	(2)	(3)	(4)	(5)	(6)
Offer_Prem	0.335*	0.413**	0.363**	0.153	0.237	0.125
	(0.194)	(0.181)	(0.183)	(0.189)	(0.194)	(0.196)
Offer_Prem^2	-0.145	-0.0533	0.0138	0.0574	0.0946	0.0809
	(0.264)	(0.256)	(0.259)	(0.260)	(0.262)	(0.264)
Offer_Prem^3	-0.107	-0.126	-0.121	-0.0604	-0.0886	-0.0538
	(0.0950)	(0.0932)	(0.0928)	(0.0901)	(0.0912)	(0.0907)
Offer_Prem^4	0.0184	-0.00946	-0.0220	-0.0420	-0.0455	-0.0482
	(0.0844)	(0.0815)	(0.0815)	(0.0794)	(0.0804)	(0.0797)
Friendly	2.338***	2.239***	2.244***	2.272***	2.259***	2.276***
	(0.132)	(0.130)	(0.130)	(0.132)	(0.130)	(0.131)
All_Cash	0.112					
	(0.0999)					
All_Stock	-0.127					
	(0.0852)					
Diversified	-0.149*	-0.171**	-0.171**	-0.169**	-0.173**	-0.169**
	(0.0774)	(0.0748)	(0.0748)	(0.0751)	(0.0749)	(0.0751)
Rival_Bid	-1.281***	-1.227***	-1.232***	-1.246***	-1.240***	-1.248***
	(0.106)	(0.101)	(0.101)	(0.102)	(0.101)	(0.102)
Sales_Growth	-0.213***	-0.231***	-0.212***	-0.194**	-0.207***	-0.194**
	(0.0814)	(0.0780)	(0.0782)	(0.0783)	(0.0778)	(0.0782)
DA	0.00132					
	(0.245)					
ROA	0.0131					
	(0.256)					
MB	-0.0200					
	(0.0155)					
PE	0.000726					
	(0.00110)					
Target_size	-0.102***	-0.107***	-0.110***	-0.112***	-0.111***	-0.112***
	(0.0320)	(0.0293)	(0.0293)	(0.0291)	(0.0293)	(0.0291)
Bidder_experience	-0.00762					
	(0.0218)					
Bidder ROA	0.0592					
	(0.432)					
Bidder sales growth	-0.0505					
	(0.0840)					
Bidder DA	-0.351					
	(0.253)					
Bidder MB	0.0410***	0.0278**	0.0272**	0.0271**	0.0260**	0.0266**
	(0.0148)	(0.0131)	(0.0130)	(0.0129)	(0.0129)	(0.0129)
Bidder PE	-0.00172					
	(0.00106)					
Bidder size	0.211***	0.222***	0.210***	0.204***	0.205***	0.203***
	(0.0289)	(0.0241)	(0.0242)	(0.0240)	(0.0242)	(0.0241)
Bidder High_Prem			-0.379***	-0.228	-0.295**	-0.209
			(0.144)	(0.149)	(0.149)	(0.152)
Dum_High				0.289***		0.273***
				(0.0791)		(0.0845)
Dum_TAPP					0.179*	0.0584
					(0.0954)	(0.100)
Industry and year FE	YES	YES	YES	YES	YES	YES
Observations	3339	3432	3432	3432	3432	3432
Pseudo R^2	0.378	0.372	0.374	0.379	0.375	0.379

Table 8: Reference Price Contribution to Predicting an Offer Acceptance

The table summarizes the predictive accuracy of two key models of offer acceptance likelihood. Panel A presents results of a model without reference prices (see Column 2 of Table 7) while Panel B is based on a model that includes significant reference prices (Column 4 of Table 7).

Panel A: Offer acceptance predictive accuracy without reference prices

		Model prediction		
		Accept offer	Reject offer	Total number
Actual outcome	Offer accepted	2930	51	2981
	Offer rejected	252	199	451
	Total number	3182	250	3432

Panel B: Offer acceptance predictive accuracy with reference prices

		Model prediction		
		Accept offer	Reject offer	Total number
Actual outcome	Offer accepted	2933	48	2981
	Offer rejected	253	198	451
	Total number	3186	246	3432

Table 9: Reference Prices' Effect on Market Reaction to Merger Announcements

The table examines the effect of our two reference prices on the cumulative abnormal returns (CARs) of target and acquirer shares around the merger offer announcement. The 3-day (A-1, A+1) and the 11-day (A-5, A+5) CARs of the target (Panel A) and the acquirer (Panel B) are reported, using the Fama-French 5-factor model and the market model for parameter estimation over the period (A-250, A-21). Only completed deals are included. Panel C estimates the combined effect of our two reference prices using the two-stage least square procedure suggested by Baker et al. (2012).
TAPP_Prem measures the impact of TAPP (target shareholders average purchase price), and is defined as Ln(TAPP/target stock price on day A-21). HIGH_Prem measures the impact of target's 52-week high price, and is defined as Ln(target's pre-offer 52-week-high price/target stock price on day A-21). *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Panel A: Target CARs (N=4187)

			TAPP_Prem			High_Prem		
		All mergers	Negative or zero	Positive	Difference in CAR	Below (or equal to) the median	Above the median	Difference in CAR
The Fama-French 5-factor model	Average CAR(-1,+1)	0.2453	0.1894	0.3151	0.1256***	0.2087	0.3043	0.0956***
	Average CAR(-5,+5)	0.2712	0.2096	0.3481	0.1386***	0.2312	0.3357	0.1045***
Market Model (CRSP value-weighted index)	Average CAR(-1,+1)	0.2456	0.1897	0.3157	0.1259***	0.2090	0.3049	0.0959***
	Average CAR(-5,+5)	0.2717	0.2101	0.3488	0.1387***	0.2321	0.3359	0.1038***

Panel B: Acquirer CARs (N=3207)

			TAPP_Prem			High_Prem		
		All mergers	Negative or zero	Positive	Difference in CARs	Below (or equal to) the median	Above the median	Difference in CARs
The Fama-French 5-factor model	Average CAR(-1,+1)	-0.0121	-0.0093	-0.0157	-0.0064***	-0.0093	-0.0149	-0.0056**
	Average CAR(-5,+5)	-0.0100	-0.0071	-0.0139	-0.0068**	-0.0074	-0.0127	-0.0053*
Market Model (CRSP value-weighted index	Average CAR(-1,+1)	-0.0122	-0.0092	-0.0161	-0.0069***	-0.0091	-0.0153	-0.0062***
	Average CAR(-5,+5)	-0.0108	-0.0073	-0.0153	-0.0080**	-0.0072	-0.0143	-0.0071**

Panel C: Two-Stage Least Squares Estimation of the Reference Prices' Effect on Announcement CARs

At the first stage we run the piecewise linear specification of the offer premium:

$$\text{Offer_premium} = \alpha + \beta_1 \text{HIGH_Prem_Large} + \beta_2 \text{HIGH_Prem_Medium} + \beta_3 \text{HIGH_Prem_Small} + \beta_4 \text{Positive_TAPP_Prem_Large} + \beta_5 \text{Positive_TAPP_Prem_Medium} + \beta_6 \text{Positive_TAPP_Prem_Small} + \beta_7 \text{Negative_TAPP_Prem_Small} + \beta_8 \text{Negative_TAPP_Prem_Medium} + \beta_9 \text{Negative_TAPP_Prem_Large} + \varepsilon,$$

with robust standard errors clustered at the target firm level; and at the second stage we estimate:

$$\text{CAR}(-1,+1) = a + b\,\text{Offer_premium(fitted value)} + \text{Controls} + \varepsilon$$

All merger, acquirer (=bidder) and target controls are described in Table 1. Robust standard errors, clustered at the acquirer firm level (Columns 1 and 2) or at the target firm level (Columns 3 and 4), are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

	(1) CAR_Acquirer	(2) CAR_Acquirer	(3) CAR_Target	(4) CAR_Target
Offer premium (fitted value)	-0.0521**	-0.0528**	0.993***	1.012***
	(0.0229)	(0.0211)	(0.0834)	(0.0843)
Friendly deal	-0.00218		-0.0466	
	(0.0115)		(0.0399)	
Rival_Bid	-0.00124		-0.0312*	-0.0324**
	(0.00674)		(0.0169)	(0.0163)
Diversified merger	-0.00178		-0.0108	
	(0.00282)		(0.0111)	
All_Cash deal	0.0225***	0.0225***	0.0806***	0.0803***
	(0.00357)	(0.00341)	(0.0121)	(0.0118)
All_Stock deal	-0.00315	-0.00305	-0.0403***	-0.0374***
	(0.00357)	(0.00341)	(0.00960)	(0.00933)
Target size	-0.00469***	-0.00476***	-0.0263***	-0.0279***
	(0.00113)	(0.000958)	(0.00439)	(0.00433)
Target sales growth	-0.00549		-0.0413***	-0.0428***
	(0.00508)		(0.0131)	(0.0124)
Target DA	-0.00427		-0.00737	
	(0.00947)		(0.0353)	
Target PE	-0.0000308		-0.000151	
	(0.0000480)		(0.000148)	
Target MB	-0.00226***	-0.00267***	-0.00899***	-0.00902***
	(0.000711)	(0.000669)	(0.00236)	(0.00228)
Target ROA	-0.00488		-0.0380	
	(0.0113)		(0.0510)	
Acquirer experience	-0.0000883		0.00148	
	(0.000350)		(0.00189)	
Acquirer ROA	-0.00279		0.193**	0.138**
	(0.0269)		(0.0781)	(0.0657)
Acquirer DA	0.0254**	0.0253***	-0.00430	
	(0.0111)	(0.00943)	(0.0343)	
Acquirer MB	-0.00173***	-0.00194***	0.00335*	0.00298*
	(0.000606)	(0.000556)	(0.00173)	(0.00165)
Acquirer size	0.00235**	0.00265***	0.0304***	0.0322***
	(0.00103)	(0.000851)	(0.00446)	(0.00426)
Acquirer PE	-0.0000346		-0.0000301	
	(0.0000496)		(0.000152)	
Acquirer sales growth	-0.00441		-0.00893	
	(0.00468)		(0.0113)	
Observations	3012	3157	3043	3107
Adjusted R^2	0.055	0.056	0.176	0.173

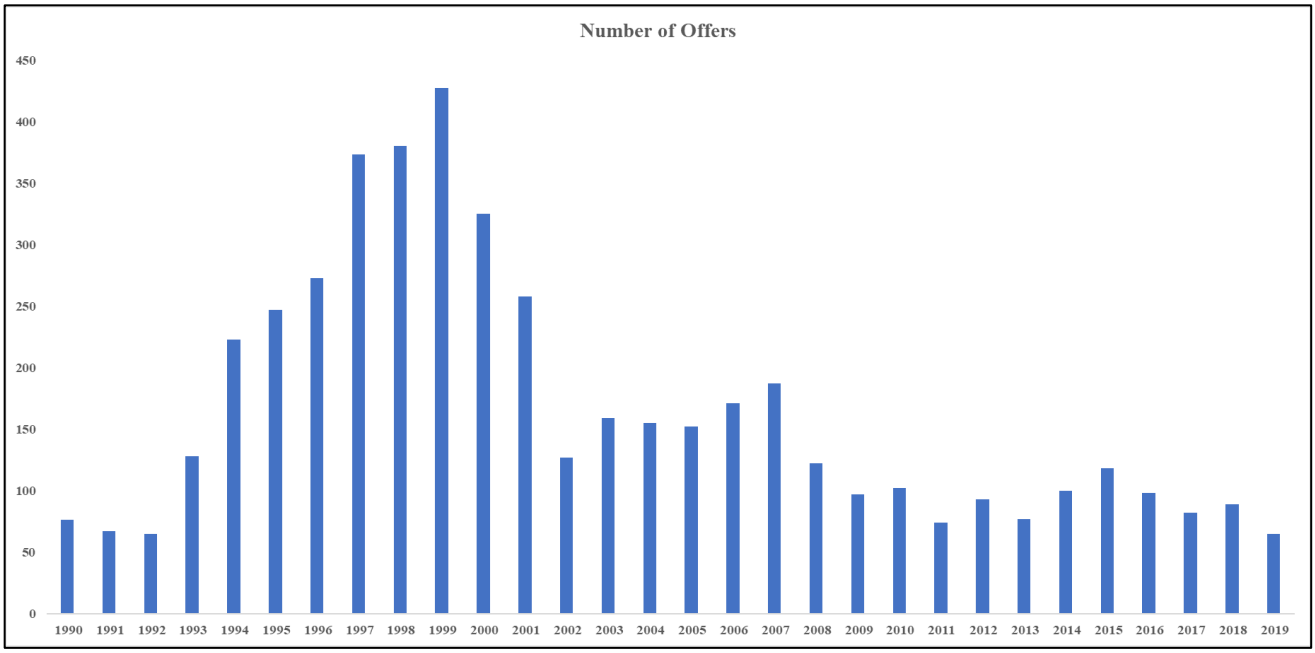

Figure 1: Yearly Distribution of Merger Offers in our Sample

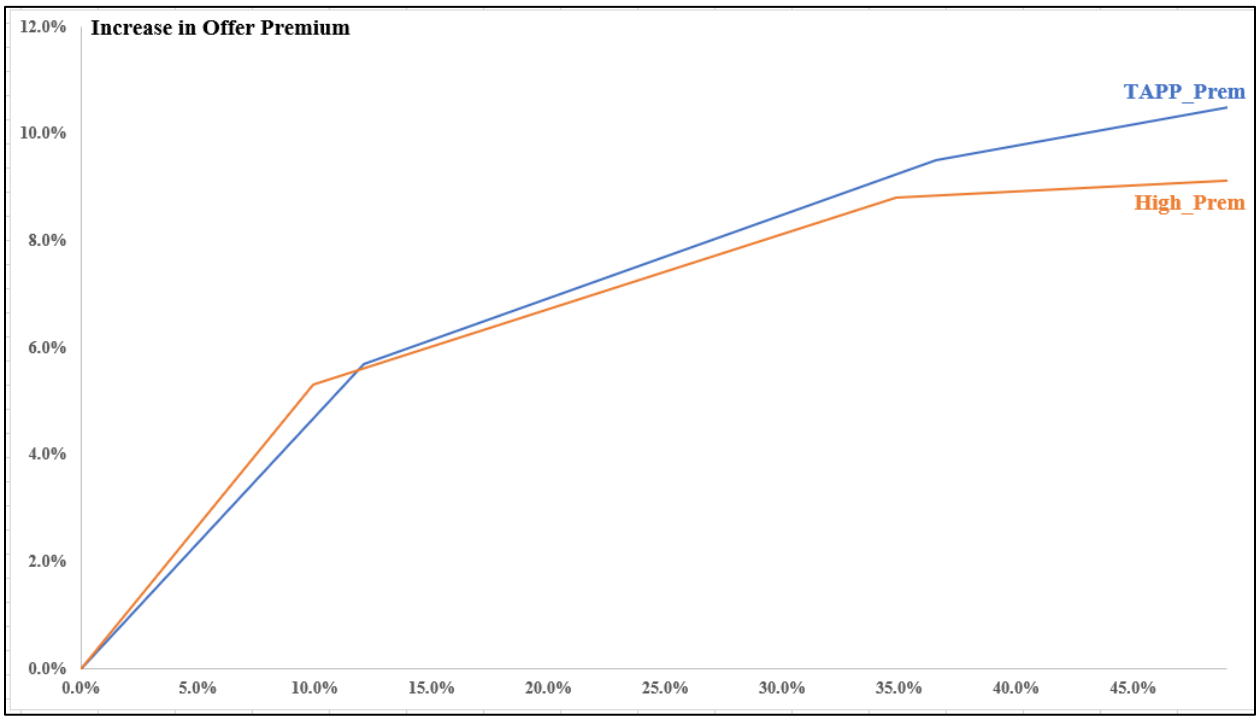

Figure 2: The Extra Premium in Loss Situations

The figure is based on the piecewise offer premium regression presented in Table 6 Column (5). We compute, and show in the figure, the extra premium offered to target shareholders when they are in a loss situation, as a function of the loss magnitude. The TAPP_Prem line represents the compensation offered to target shareholders' for their loss relative to our estimate of their average purchase price (TAPP), while the High_Prem line represents compensation for the loss relative to the pre-offer 52-week high price of the target stock (more details in Table 6 and the text). The total compensation for losses relative to reference prices is the sum of the appropriate compensation for each of the losses. The cutoff losses between the three segments of the TAPP_Prem (High_Prem) line is 12.1% and 36.6% (10% and 34.9%, respectively).