

Endogenous Limits to Arbitrage and Price Informativeness

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Abstract

Theory suggests that traders are reluctant to trade on negative private information about a corporate decision if their trading can cause a reversal of the decision. We provide evidence for such endogenous limits to arbitrage in the context of mergers. Starting from the observation that an acquirer termination fee increases the cost of canceling a transaction, potentially breaking the feedback loop between prices and decisions, we find the amount of firm-specific information in post-announcement acquirer stock prices to be significantly lower if no termination fee is used than when a termination fee is used.

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1 Introduction

The various versions of the market efficiency hypothesis state that security prices reflect available information. This view is consistent with a mechanism where information is collected and processed by market participants and their subsequent trading causes prices to reflect this information. The traditional view is that the process through which prices become informative ends here. A recent literature has investigated the possibility that corporate managers pay attention to stock prices and adjust their corporate decision in accordance with what they learn. When managerial decisions are affected by stock prices, there will be a feedback loop between prices and decisions that may impact the degree of market efficiency. Edmans, Goldstein, and Jiang (2015) argue that feedback between prices and decisions may deter investors from trading on private information. In a merger setting, the intuition for their argument is as follows: If speculators have private negative information about a proposed merger, they will short the buyer's stock. But if the acquirer management pays attention to the market reaction to the proposed merger, they will realize that the deal is bad and cancel the transaction. This leaves the speculators with a losing short position. Thus, the speculators will not short the stock in the first place, the acquirer price won't reflect as much negative information as is available to speculators, and the management will execute a suboptimal decision. Consequently, welfare decreasing endogenous limits to arbitrage have occurred.

This paper's main contribution is to provide empirical evidence on this particular form of limits to arbitrage and its impact on price informativeness. Endogenous limits to arbitrage will be absent if the feedback loop between stock prices and management decisions is broken. In the context of mergers, the feedback loop can be broken when an acquirer has agreed to compensate the seller if the transaction is cancelled by the acquirer. Such compensation is commonly referred to as a termination fee.¹ A large acquirer termination fee will make deal cancellation more costly and, consequently, less likely. This should induce informed traders to trade on their information making prices informative. We use a large sample of merger announcements and compare the information content of post announcement stock prices for acquirers committed to pay a termination

¹The average ratio of acquirer termination fee to the market capitalization is around 2.73% in our sample. This exceeds the average dividend yield of 2.24% recorded for the S&P500 index over our sample period.

fee to the corresponding measure for acquirers without such commitment. We find that the post announcement stock price of acquirers in deals with acquirer termination fees contains considerably more firm specific information than the stock price of acquirers that have not agreed to pay a termination fee. In our sample, our price-informativeness measure more than doubles compared to the sample average when a termination fee is used. This finding is consistent with the existence of endogenous limits to arbitrage and demonstrates their significant impact on price efficiency.

We reinforce this evidence in several ways. First, the feedback from stock prices to management decisions is asymmetric. While a negative stock price response might induce the management to reconsider its decision, a positive response shows that the market agrees with management making deal cancellation less likely. Thus, only after receiving a negative signal, will speculators be concerned about their trading causing deal cancellation. It follows that only in such cases will a termination fee ease these concerns and increase trading and price informativeness. To test this refined implication of endogenous limits to arbitrage, we split the sample into a subsample of mergers likely to come with a negative signal and a subsample where a positive signal was more likely. In support of the theory, we find that the use of an acquirer termination fee increases price informativeness only in the bad-signal subsample, while the estimated effect is insignificant and close to zero in the good-signal subsample.

Second, we address endogeneity concerns arising from the fact that the inclusion of a termination fee is a choice. When negotiating the terms of a merger transaction, the acquirer and the seller negotiate over multiple issues simultaneously. The inclusion of an acquirer termination fee will in some transactions be part of the set of issues to agree on. Thus, the inclusion of an acquirer termination fee in the merger agreement will be a choice variable related to other observable and unobservable variables. If the choice of including a termination fee is related to unobservable variables that also influence price informativeness, we are facing an endogeneity problem that can potentially bias our estimate of the effect of including a termination fee. A case in point are private benefits the management of the acquirer might derive from running a larger firm. In that case, the management is more likely to complete the transaction if the stock market reaction is negative, which should increase the willingness to trade on private information and thus price

informativeness. Such private benefits are also likely to affect the bargaining process leading to the merger agreement. One can think of different ways private benefits could affect the bargaining outcome, with some economic mechanisms making the inclusion of an acquirer termination fee more likely while others making it less likely. Since the different mechanisms produce different biases in the OLS regression, the comparison between the OLS and the IV regression outcomes allows us to shed some light on the mechanism at work.

To deal with this potential endogeneity problem, we introduce instrumental variables for the usage of acquirer termination fees. In the 1994 case *Paramount v. QVC Network*, the court ruled that the stock lockup option granted by Paramount to a prospective bidder Viacom was invalid, while the \$100 million termination fee was upheld. The court viewed the termination fee to be a reasonable amount to cover Viacom's expenses in connection with the merger process. After this court ruling, the number of mergers with acquirer termination fees increased sharply and the relation between termination fee use and its determinants changed considerably. We use a dummy variable that equals one for the period 1994–2018 and zero for the period 1986–1993 as an instrumental variable for the usage of acquirer termination fee. We identify a structural break in the influence of acquirer, target, and deal characteristics on the use of termination fees following the ruling. Consequently, we incorporate interaction terms of the dummy variable with these characteristics as additional instruments. These variables act as instruments for the acquirer termination fee in a standard instrumental variable approach and in an endogenous switching model. The latter is used because the assumptions underlying the instrumental variable approach do not fully agree with the suspected economic mechanism causing the endogeneity problem. The coefficient estimates of these two approaches greatly exceed the OLS-estimates and reveal an economically significant effect of endogenous limits to arbitrage. The sign of the OLS-bias is informative in itself and suggests that the target management recognizes opportunistic merger motives of the acquirer management. In such cases, the target management is less concerned about the transaction failing and instead uses its bargaining power to secure other concessions, rather than a termination fee, in the bargaining leading to the merger agreement.

Finally, we show that our results are not driven by the trading of merger arbitrageurs. Their

trading involves buying the target’s stock and shorting the stock of the acquirer in such a way that the short and long side perfectly match each other if and when the transaction closes. Merger arbitrageurs aim to pocket the gap typically seen between the target stock price right after the announcement and the offered acquisition price. While they care about the merger success probability, they do not care about the quality of the merger per se. Their strategy always involves shorting the bidder. It is not clear whether their trading makes prices informative in the same way the trading of informed traders does. For that reason, we investigate whether our earlier results hold in a subsample of mergers with non-listed targets. In these cases, merger arbitrageurs cannot acquire a long position in the target, making the merger arbitrage trade impossible. We find that all our findings hold in this subsample, as well.

This paper adds to the literature on the mutual feedback between the stock market and corporate decisions. Dow and Gorton (1997), Subrahmanyam and Titman (2001), Bond, Goldstein, and Prescott (2010) and Dow, Goldstein, and Guembel (2017) show theoretically how stock prices may affect corporate decisions. Baker, Stein, and Wurgler (2003), Chen, Goldstein, and Jiang (2007a) and Ferreira, Ferreira, and Raposo (2011) show that prices can affect corporate investment decisions as well as the corporate governance. Luo (2005) and Kau, Linck, and Rubin (2008) study the feedback effect in takeovers. They find that acquiring firms pay attention to the market reaction to the transaction announcement and document a larger probability of deal cancellation when bidder announcement return is negative. Edmans, Goldstein, and Jiang (2011) show, using an instrument for undervaluation, that prices can trigger an acquisition. While the previously mentioned empirical literature studies the feedback from security prices to corporate decisions, our paper provides evidence on how the feedback between prices and corporate decisions results in endogenous limits to arbitrage and, consequently, influences market efficiency.

A paper closer to ours is Gorton, Huang, and Kang (2017), which study the interaction between information production and CEO replacement. While Edmans, Goldstein, and Jiang (2015) explore theoretically and our paper explores empirically whether feedback destroys the trading incentives of informed traders, Gorton, Huang, and Kang (2017) show that feedback lowers the incentive of traders, who are assumed to always trade mechanically, to get informed. The authors explore the

empirical relation between CEO turnover and the probability of informed trading (PIN).² It has been shown that PIN struggles to capture price informativeness around corporate events known to generate new and relevant firm specific information. For example, Aktas, de Bodt, Declerck, and Van Oppens (2007) find that PIN is lower before merger and acquisition announcements, which contradicts the evidence on information leakages prior to merger announcements. Collin-Dufresne (2015) finds that PIN is lower on days which Schedule 13D filers trade, and concludes that PIN do not reveal the presence of informed traders. Following Roll (1988) and Chen, Goldstein, and Jiang (2007b), this paper uses firm specific stock return variation instead of PIN as the measure of price informativeness. This measure has been found to be highly correlated with stock prices' ability to predict firms' future earnings (Chen, Goldstein, and Jiang, 2007b) and to be considered by a firm's management for investment decisions (Veldkamp, 2006).

Our paper is also related to the takeover deal protection literature, which has mostly been concerned with target termination fees. There is little work on understanding acquirer termination fees. Exceptions include Bates and Lemmon (2003) and Chen, Mahmudi, Virani, and Zhao (2021). Bates and Lemmon (2003) point out that an acquirer termination fee can be regarded as an insurance for targets. They support this view with evidence showing that acquirer termination provisions are more common in deals with higher cost of deal failure for targets. Chen, Mahmudi, Virani, and Zhao (2021) provide an alternative view. They point out that the acquirer termination fee provide the bidder with an option to cancel the transaction at the cost of paying the termination fee. We find support for the insurance motive. An acquirer termination fee is more likely used in a merger agreement if the acquirer has difficulties financing the deal or is about the same size as the target. In addition, we find evidence that deals that are more likely to be pursued for the private benefits of the bidder management are less likely to include an acquirer termination fee.

The rest of the paper is organized as follows. Section 2 introduces the main empirical hypotheses. Section 3 describes our data. Section 4 outlines the empirical approach and section 5 presents our main empirical findings. Section 6 investigates the robustness of the main findings in a subsample where merger arbitrageurs are absent. Section 7 concludes.

²For further details on PIN, see Easley, Hvidkjaer, and O'Hara (2002) and Easley and O'Hara (2004).

2 Hypotheses

The development of testable hypotheses and empirical investigation of endogenous limits to arbitrage is inspired by the model of Edmans, Goldstein, and Jiang (2015) (henceforth the EGJ model) and Boleslavsky, Kelly, and Taylor (2017). In the EGJ model, a speculator has private information about the cash flow effects of an investment announced by a firm. The informed speculator would like to trade on and profit from this information while the firm’s management would like to learn more about the value of the investment from the stock market reaction. A speculator who has negative private information worries that the investment will be abandoned if his private information is revealed by selling or shorting the stock. The price recovery caused by canceling the investment will result in a loss for the speculator, who adjusts his trading behavior in such a way that trades are less likely to reveal his negative information when combined with the random trades of noise traders. His expected profit from trading therefore depends on the chance of revelation and trading costs, which can be substantial if shorting is involved. If the chance of revelation or the trading costs are too high, the speculator refrains from trading, prices won’t be informative, and the management will execute a suboptimal decision. In such a scenario, the feedback loop between trading and corporate decisions endogenously caused limits to arbitrage and a welfare loss.³

The primary goal of this paper is to investigate the existence of such endogenous limits to arbitrage and assess their impact on price informativeness. To empirically investigate this idea, we require a situation where the feedback loop is sometimes switched off. Anything that induces the management to hold on to a planned investment even if the market reacts negatively will lift the limits to arbitrage. Merger decisions provide such a situation. An acquirer termination fee is a device that creates a commitment for the acquirer to go through with an announced merger even if the market reacts negatively to the merger announcement. Since not all mergers involve acquirer termination fees, mergers are a suitable setup to test for the existence and consequences of endogenous limits to arbitrage. Mergers involving acquirer termination fees should represent

³Such an equilibrium with endogenous limits to arbitrage is one of several possible equilibria in the EGJ model. In another equilibrium, speculators will always trade. This is the case if trading costs are negligible and the probability of revelation is sufficiently low. For very high trading costs, a third type of equilibrium with informed speculators not trading at all exists. This corresponds to the classical limits to arbitrage case brought about by transaction costs.

trading opportunities for informed speculators and prices should reflect their information. Mergers without such termination fees, should be affected by endogenous limits to arbitrage and, as a consequence, prices should be less informative. If endogenous limits to arbitrage exist, then we should observe that:

Hypothesis 1a. Price informativeness is higher for acquirer stocks following the announcement of mergers that include an acquirer termination fee than for acquirers in mergers not including an acquirer termination fee.

That the bidder has agreed to an acquirer termination fee does not mean that it has tied its hands and will go through with the merger at any cost. Bidder management is likely to compare the value implications of the market signal to the size of the termination fee. The larger the termination fee, the more likely this comparison favors continuing with the merger. Thus, if endogenous limits to arbitrage exists, then

Hypothesis 1b. The price informativeness is increasing in the size of the acquirer termination fee.

Only informed speculators with negative information need to worry about deal withdrawal. Positive private information will be welcomed by the management, making a withdrawal highly unlikely. We, therefore, expect endogenous limits to arbitrage to arise for bad mergers only:

Hypothesis 2. The hypothesized relation between price informativeness and acquirer termination fee is only present when speculators receive bad information about the merger. When speculators receive good information about the merger, price informativeness should be independent of acquirer termination fee.

3 Data, variable definitions and descriptive statistics

3.1 Data and sample selection

Data on merger transactions is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). Table 1 details the sample selection procedure. We start with all mergers by U.S. and publicly listed acquirers announced between 1986 and 2018 where the deal value is available. This results in a sample of 22,254 mergers. Next we require the acquirer to be present in the data from Center for Research in Security Prices (CRSP) and in Compustat. We also require the bidder to be present in CRSP with common shares (share codes 10 or 11) and the announcement date to be within the CRSP time-series of daily returns. This reduces the sample to 17,550 mergers. We only keep the first announcement in a bidding contest, require stock price and number of shares to be available 42 days prior to the announcement (to compute market capitalization), require Compustat total assets to be available for the fiscal year-end prior to the announcement, and the relative deal size to be larger than 1%.⁴ This reduces the sample to 14,817 mergers.

In studies using a sample of mergers, it is common to drop financials and utilities because they are regulated industries. In our study, we rely on the notion that there are privately informed speculators following the acquirer. Financials are often regarded as some of the more challenging firms to understand and value in practice. For that reason, one can argue that speculators willing to put in the effort have a chance of setting themselves up with information few others have—in other words, private information. We therefore keep financials but drop utilities. This leaves us with a sample of 14,545 mergers. In most of our analysis, we include a set of independent variables (covariates) that further reduce the sample size. This gives a sample of 12,519 over the sample period 1986–2018.

Panel A of Figure 1 breaks down the number of mergers by year. The well known surge in merger activity during the 1990s is clearly present in our data. Panel B shows the number of transactions that includes an acquirer terminations fee by year. Prior to 1994 there are few

⁴Relative deal size is measured as deal value divided by market capitalization of the bidder measured 42 days prior to the announcement.

termination agreements. The number jumps in 1994 and stays at a higher level after that.⁵ The jump in the usage of acquirer termination fees corresponds to the *Paramount v. QVC Network* ruling where the court found that the \$100 million termination fee reasonably reflected Viacom’s expenses in connection with the merger. We later exploit this as an instrument for the usage of acquirer termination fee.

3.2 Key variables

This section describes how we measure price informativeness, the existence of an acquirer termination fee agreement, and the size of an acquirer termination fee. We also provide descriptive statistics on these and other variables used in the study. All variable definitions are summarized in Appendix Table A1.

Price informativeness. To empirically examine our hypotheses 1a, 1b and 2, we measure stock price informativeness as firm specific stock return variation (also referred to as price non-synchronicity). Roll (1988) finds that stock price movements, beyond general market movements, cannot be explained by identifiable news releases. Thus, firm specific price movements are consistent with speculators gathering and trading on their private information. The intuition is as follows: Stock return movements are driven by information from two sources, general public information and firm-specific private information. Public information is reflected in market return and industry return. The part of return that cannot be explained by market return and industry return must be driven by the firm-specific private information. Based on this argument, if the stock prices of a firm contain more firm-specific private information, the return of the stock should be less correlated with the market or industry return, and therefore has greater firm-specific return variation. Prior empirical studies have provided evidence supporting the notion that firm-specific return variation reflects private information and has features important for our study. For example, Durnev, Morck, Yeung, and Zarowin (2003) find that firm-specific return variation indicates that prices are informative since it is associated with stock prices’ ability to predict firms’ future

⁵In 1993, 1.2% of deals had an acquirer termination fee while 6.1% of deals in 1994 had a termination fee.

earnings. Chen, Goldstein, and Jiang (2007b) find that the amount of private information in stock prices has a strong effect on the sensitivity of investments to stock prices, suggesting that the management “listens more to the market” when firm-specific return variation is high.⁶

We capture firm specific stock return on day t using the following regression model:

$$r_{it} = a_i + b_i r_{mt} + c_{ij} r_{jt} + s_i smb_t + h_i hml_t + \epsilon_{it}, \quad (1)$$

where r_{it} is the daily excess return for firm i on day t , r_{mt} is the market excess return, smb_t is the size factor, hml_t is the book-to-market factor, r_{jt} is the return on industry j in which firm i is a member, and $\{a, b, c, s, h\}$ are parameters to be estimated.⁷ The firm specific stock return is measured using the residuals, $\hat{\epsilon}_{it}$, from the above regression. The model is estimated using daily trading dates $t + 2$ through $t + 22$, where $t = 0$ is the merger announcement date. The R-squared from this regression, denoted R_i^2 , measures the variation in r_{it} explained by the market, the industry, the size factor and the book-to-market factor. Consequently, $(1 - R_i^2)$ captures the variation in r_{it} not explained by the market and the firm’s own industry. We use

$$y_i = \ln \left(\frac{1 - R_i^2}{R_i^2} \right) \quad (2)$$

as our measure of stock price informativeness. The higher this number the more firm specific information is captured by stock prices.

Termination Fee D. Dummy variable equal to one if the merger agreement includes a bidder termination fee and the Termination Fee Size, as defined below, is larger than its 25%-quantile (of all nonzero Termination Fee Size observations) and zero otherwise. With this cutoff we aim to identify the fee size necessary to induce the bidder management to hold on to a deal. We find that the use of a termination fee leads to a strong and significant reduction of the deal cancellation

⁶Other papers have used similar proxies and documented effects that are consistent with the view that these proxies capture the amount of private information in prices. E.g., Morck, Yeung, and Yu (2000) find that countries with a well-developed financial system in general have higher firm-specific return variation. Veldkamp (2006) shows that traders rely more on signals common to many firms if firm-specific information is hard to obtain. This leads to a drop in price non-synchronicity. See Chen, Goldstein, and Jiang (2007b) for further examples.

⁷We use Fama-French 30 industry portfolios.

probability if the fee exceeds its 25%-quantile (see section 3.3 for the details).

Termination Fee Size. Hypothesis 1b captures the idea that bidder managers are less likely to cancel a transaction if they have agreed to a large termination fee. We normalize the termination fee by dividing it by the market capitalization of the acquirer, measured 42 trading dates prior to the merger announcement. For the regression analysis, we want to consider only large enough termination fees. For that reason, the variable termination fee size corresponds to the original ratio multiplied by the termination fee dummy defined above.

Panel A of Table 2 reports descriptive statistics for the termination fee measures and the dependent variables used in this study. We have 12,519 observations for the “Termination Fee D” variable. An average value of 0.07 implies that 7% of mergers in our sample include an acquirer termination fee with a size exceeding the 25%-quantile. The second row in Panel A shows that, conditional on Termination Fee D being equal to one, the termination fee is on average 3% of acquirer market capitalization. This is a significant fee that will have to be paid to the target if the acquirer decides to cancel the transaction. It exceeds the 2.24% average dividend yield of the S&P500 index recorded over that sample period.

Panel A also shows that mean and median price informativeness are very similar at 0.73 and 0.72 respectively. The mean price informativeness for mergers with an acquirer termination fee is not statistically different from that for mergers without a termination fee. To uncover the effect of a termination fee, we need to partial out the impact of other determinants of price informativeness. Panel A also reports the frequency of withdrawn transactions. On average 9% of announced transactions get canceled. The cancellation frequency in the sample of transactions with an acquirer termination fee and the sample without such a fee are almost the same. However, as we show in the next section, the usage of an acquirer termination fee has a highly significant and sizable impact on the withdrawal probability if other determinants of deal cancellation are properly controlled for.

Panel B of Table 2 presents summary statistics for all variables used as control variables in this paper. Notice that the deal value is significantly larger for deals with Termination Fee D equal to one. In other words, small deals tend not to contain an acquirer termination fee. Similarly,

transactions with publicly listed targets are more likely to include an acquirer termination fee. Acquirers with a termination fee also tend to have worse past one-year stock market performance, higher runup and lower announcement abnormal return.

3.3 Acquirer termination fee and likelihood of deal cancellation

The premise of our analysis is that an acquirer termination fee makes it less likely that the acquirer cancels the transaction. Only then is a termination fee a commitment to go through with the merger—potentially inducing informed speculators to trade on their private information. In this section, we show that deals involving an acquirer termination fee are considerably less likely to be canceled.

Define Withdrawn as a dummy variable equal to one if the deal was canceled and zero if the deal was completed. Table 3 documents the results of a probit regression with Withdrawn as the dependent variable. Column (1) of Table 3 reports the results of a probit model which uses four dummy variables based on the four quartiles of the relative termination fee size. The dummy variables representing the second to the fourth highest quartiles have a significantly negative effect on the withdrawal probability. This result supports our decision to set our termination fee dummy variable equal to one for all deals that have a termination fee exceeding the 25%-quantile. Column (2) of Table 3 shows that the probability of deal cancellation is lower if the transaction includes a large termination fee than when it does not (z-statistic of -3.86). Using a termination fee decreases the probability of deal cancellation by 34% (average marginal effect). This finding is consistent with our premise that a termination fee increases the cost of canceling a merger and thus cancellation becomes less likely. Column (3) shows that the termination fee dummy has an even larger effect on the probability of cancellation when also controlling for termination fee size. The positive marginal effect of termination fee size is consistent with the finding in Column (1) that the effect of a termination fee is not as pronounced if a very large fee is used.

The likelihood of deal cancellation is also increasing in the value of the transaction and is higher if the target is listed. Unsurprisingly, the deal is more likely to be canceled if the bid for the target is unsolicited. The deal is less likely to be canceled if the market capitalization of the

bidder is large and if the bidder and the target operate in the same industry. Finally, we find that the announcement effect has no impact on the cancellation probability but the runup prior to the announcement does.

Finally, using the realizations of the covariates and setting the termination fee dummy to zero, we find from the probit model, that the majority of transactions with a termination fee has a predicted probability of deal cancellation above the mean predicted probability. In other words, termination fees are mostly used when the probability of deal cancellation is high. But when a termination fee is used, it comes with a significantly reduced probability of deal cancellation.

In sum, transactions with an acquirer termination fee have a significantly lower probability of deal cancellation than otherwise similar transactions without a termination fee. Thus, the findings in Table 3 justify using acquirer termination fees to separate feedback equilibria, where endogenous limits to arbitrage might exist, from no feedback equilibria, where such limits don't exist. With that result established, we can move on to test for the existence of limits to arbitrage by analyzing price informativeness.

4 Empirical Strategy

In the previous section, we showed that a deal is considerably more likely to be completed if it includes an acquirer termination fee. Hence, the acquirer termination fee has the potential to shut down the endogenous-limits-to-arbitrage mechanism—if it exists. Thus, we should observe more informative prices after a merger announcement if the merger agreement contains an acquirer termination fee. This is hypothesis 1a. A simple approach to test this hypothesis is to regress price informativeness of the bidder in merger i , denoted by y_i , on the termination fee dummy t_i and a vector of control variables x_i :

$$y_i = \alpha + x_i\beta + \gamma t_i + e_i \tag{3}$$

The coefficient γ represents the effect of shutting down the endogenous-limits-to-arbitrage mechanism with a termination fee. However, specific assumptions need to hold for γ to capture that

effect. A particular concern is that the termination fee choice must not depend on unobservable variables that also affect price informativeness. We discuss why economic theory suggests such unobservable factors are confounding the termination fee choice and how we deal with this challenge in the next sections. To facilitate this discussion and derive estimable equations, we cast the relationship between termination fee use and price informativeness in the form of the potential outcome model (4) and (5):⁸

$$y_{0i} = \alpha_0 + x_i\beta_0 + u_{0i} \quad \text{if } t_i = 0 \quad (4)$$

$$y_{1i} = \alpha_1 + x_i\beta_1 + u_{1i} \quad \text{if } t_i = 1 \quad (5)$$

where y_{1i} and y_{0i} are the price informative measures after the announcement of merger i if a termination fee is used ($t_i = 1$) or not used ($t_i = 0$). The vector x_i contains other determinants of price informativeness, whose effects might depend on the presence of a termination fee. The error terms u_{0i} and u_{1i} are zero mean satisfying $E[u_{gi}|x_i] = 0$ for $g = 0, 1$ and unobservable to us, potentially known by the parties involved in the transaction and trading, and possibly related to the termination fee choice (see section 4.1).

If the inclusion of a termination fee induces informed traders to participate and make prices more informative, then the difference $y_{1i} - y_{0i}$ should be positive on average, i.e., $E[y_{1i} - y_{0i}] > 0$. $E[y_{1i} - y_{0i}]$ corresponds to the average treatment effect (ATE), where the treatment is the use of an acquirer termination fee. A slightly less demanding but sufficient test for the presence of endogenous limits to arbitrage is to test whether the deals including a termination fee exhibited a higher price informativeness, i.e., $E[y_{1i} - y_{0i} | t_i = 1] > 0$. $E[y_{1i} - y_{0i} | t_i = 1]$ corresponds to the treatment effect on the treated (ATT) and only requires the counterfactual y_{0i} for the treated. Thus, hypothesis 1a can be recast as the ATE or the ATT being positive and we will always report estimates for both.⁹

⁸The discussion draws on Wooldridge (2010) and Maddala (1983).

⁹In principle, the ATT is sufficient to test for the presence of endogenous limits to arbitrage. For the standard OLS and IV specifications, ATE is even equal to ATT. However, the sample of acquirers that end up using a termination fee might be tilted towards certain firm characteristics. E.g., smaller bidders are more likely to agree to a termination fee. For understanding the consequences of endogenous limits to arbitrage for the population of firms, we also estimate the average effect for the broader population, the ATE. To ensure identification of the ATE, we will not only deal

Since we observe only y_{1i} for a merger with a termination fee and only y_{0i} for a merger without a termination fee, the expectation of the respective counterfactual outcome has to be estimated from the data. In the cross section of mergers, we can express the observed price informativeness as: $y_i = y_{0i} + t_i(y_{1i} - y_{0i})$. Plugging equations (4) and (5) into this relationship allows us to write observed price informativeness in the form of a switching regression:

$$y_i = \alpha_0 + x_i\beta_0 + (\alpha_1 - \alpha_0)t_i + t_ix_i(\beta_1 - \beta_0) + u_{0i} + t_i(u_{1i} - u_{0i}) \quad (6)$$

If we are able to consistently estimate the parameters of this switching regression from the set of observable variables (y_i, t_i, x_i) , then we can calculate the treatment effects and test our hypotheses. To succeed, we need to solve the problem that t_i might be correlated with the error terms u_{0i} and u_{1i} . The same problem plagues the dummy-variable regression (3), where $\beta_1 = \beta_0$ and $\gamma = \alpha_1 - \alpha_0$. We will approach the estimation problem in three different ways: OLS, using instrumental variables, and an endogenous switching regression. The later two approaches were chosen because finance theory and previous empirical results suggest that, in our merger sample, the first approach is vulnerable to endogeneity problems.

Our first approach (OLS) to estimating the treatment effects is based on the assumption that, conditional on a set of covariates x_i , (y_{i0}, y_{i1}) and t_i are mean-independent. It is common to refer to this as the unconfoundedness assumption.¹⁰ Given model (6), unconfoundedness implies that t_i and u_{i1} , as well as t_i and u_{i0} are independent conditional on x_i and we can subsume the error terms as in equation (7):

$$y_i = \alpha_0 + x_i\beta_0 + (\alpha_1 - \alpha_0)t_i + t_ix_i(\beta_1 - \beta_0) + \epsilon_i \quad (7)$$

Given the unconfoundedness assumption, we can use the regression results of equation (7) to esti-

with the termination fee choice but will also make sure that the observed outcome and the calculated counterfactual outcome are derived from comparable samples (overlap assumption). Focusing on the ATT would allow us to work with a less restrictive overlap assumption.

¹⁰Also known as ignorability of treatment or conditional independence assumption. The assumption implies $E(y_{gi} | x_i, t_i) = E(y_{gi} | x_i)$ for $g = 0, 1$. The assumption is violated, if a variable is omitted that influences both price informativeness and termination fee choice.

mate a conditional $ATE(x_i) = \alpha_1 - \alpha_0 + (\beta_1 - \beta_0)x_i$. Moreover, we have $ATE(x_i) = ATT(x_i)$. The ATE and ATT are then derived by averaging $ATE(x_i)$ over all merger observations i in the case of ATE or over the mergers with a termination fee in the case of ATT. The two treatment effects are only identified if for every covariate vector x_i there are both mergers with and mergers without termination fee. This is referred to as the “overlap” assumption (Imbens and Wooldridge, 2009, e.g., see).¹¹ We attempt to ensure that overlap is fulfilled in several ways. We trim observations with extreme propensity score and run regression (7) on such adjusted samples. We will also derive estimates for ATE and ATT using inverse probability weighting, propensity score matching, and nearest-neighbor matching.¹²

4.1 Sources of endogeneity and the bias of OLS estimates

The consistency of the OLS estimates hinges on the unconfoundedness assumption. Existing theories and empirical evidence on managerial merger motives, however, give reason to doubt that this assumption holds. In this section, we will discuss potential economic mechanisms that suggest unobservable variables could affect both the termination fee choice and price informativeness. The discussion attempts to accomplish two goals. First, we identify private benefits of control as a potential source of endogeneity and suggest appropriate econometric techniques that deal with this problem. Second, we show that an estimate of the OLS bias can tell us something about the mechanism through which private benefits of control influence price informativeness and the termination fee choice.

An obvious concern is that the acquirer management pursues an acquisition for its own private benefits. Such private benefits can come in various forms. Underdiversified managers might pursue an acquisition to diversify their personal wealth (Amihud and Lev, 1981). Managers might use the free cash flow to increase the size of the firm (Jensen, 1986), since managing larger firms tends to bring along increased reputation and higher salary. Managers might conduct acquisitions to improve their job security by either increasing the firm’s dependence on the current management

¹¹Formally: $0 < \Pr(t_i = 1 \mid x_i = x) < 1$, for all x . For the calculation of the ATT, the weaker condition $\Pr(t_i = 1 \mid x_i = x) < 1$ is sufficient.

¹²See Imbens and Wooldridge (2009) or Wooldridge (2010) for details on these approaches.

or by acquiring divisions at which they might be better managers (Shleifer and Vishny, 1989).¹³ Empirical evidence consistent with managerial private benefits as acquisition motives are provided in a series of papers, as, for example, in Morck, Shleifer, and Vishny (1990), Lang, Stulz, and Walkling (1991), Berkovitch and Narayanan (1993), Masulis, Wang, and Xie (2007), and Harford, Humphery-Jenner, and Powell (2012).

Whatever the source of private benefits, we expect bidder managers to be more willing to over-pay and be more adamant in completing an acquisition if it provides such private benefits. This also implies that they are more likely to ignore a negative stock price reaction to the announcement.¹⁴ If informed traders are aware of the private benefits, they are more likely to trade and price informativeness should increase. In sum, private benefits of control should make prices more informative.

Next we look at how private benefits of control might affect the termination fee choice. There is little theoretical work on why acquirer termination fees are included in merger agreements. Bates and Lemmon (2003) and Chen, Mahmudi, Virani, and Zhao (2021) provide arguments for why a termination fee is optimal for acquirer shareholders in certain circumstances. If the acquirer management pursues a merger for its own private benefits, we see at least three ways in which the termination fee choice could be affected. First, acquirer managers with private benefits of control will prefer a merger that allows their control to be retained. They are less likely to cancel such mergers and, consequently, will perceive the potential cost of agreeing to a termination fee as small. Second, managers might sign an expensive termination fee agreement to have an excuse vis-a-vis the shareholders for holding on to a deal that might later turn out to not be beneficial for the acquirer. In both these cases, private benefits make the use of a termination fee more likely.

If private benefits are positively correlated with the use of termination fees and positively correlated with price informativeness, the OLS estimate of the effect of a termination fee in equation

¹³Earlier discussions of deviations from shareholder maximization can be found in Baumol (1959) and Williamson (1964), who suggest sales and expense maximization, respectively, as potential managerial objectives. Marris (1964) develops a theory of the firm based on sales growth maximization and Mueller (1969) builds on this theory to develop an explanation for conglomerate mergers.

¹⁴Shareholders might punish the managers for making bad acquisition decisions at some point or the firm might become a takeover target itself (Mitchell and Lehn, 1990) but there is clear evidence that shareholders don't react immediately to every value-decreasing decision and takeover is an expensive undertaking employed only when the gains are sufficiently large.

(7) will be biased upward. This happens because the termination fee also captures the effect of private benefits.

The third possibility produces the opposite bias. If the target management realizes that the acquirer management is unlikely to cancel the transaction because of significant private benefits, target management might decide to use its bargaining power to obtain other concessions than a termination fee. This argument implies that it is less likely to observe a termination fee when the acquirer management has private benefits of control. If the informed traders are aware of the managerial motive for the merger, they will trade on their information even if no termination fee is used. This behavior inflates the average price informativeness of the mergers without such a fee, lowering the OLS coefficient estimate of the termination fee variable.

In light of the discussion above and the existing empirical evidence on private benefits as a merger motive, it is plausible that there are significant correlations between the unobservable determinants of the termination fee choice and the error terms u_{0i} and u_{1i} . To deal with this endogeneity problem, we will use two different approaches: instrumental variable estimation and an endogenous switching regression.

4.2 IV and endogenous switching model

Our first solution to the endogeneity problem is to use an instrument that is correlated with termination fee use but not with the error terms u_{0i} and u_{1i} in equation (6). Bates and Lemmon (2003) and Officer (2003) document that acquirer termination fees became much more common after the *Paramount v. QVC Network* Delaware court ruling in February 1994. The court ruled that the stock lockup option granted by Paramount to a prospective acquirer Viacom was invalid, while the \$100 million termination fee was ruled to be a reasonable amount to cover Viacom's expenses in connection with the transaction. Although this concerned a target termination fee, it has also eliminated the legal uncertainty surrounding the use of an acquirer termination fee. This can be seen in Panel B of Figure 1, where we see a sharp increase in the use acquirer termination fees starting in 1994.

We rely on the *Paramount v. QVC Network* court ruling as an exogenous shock to the usage

of acquirer termination fees and define Paramount as an indicator variable that is equal to zero for the eight first years of the sample period, 1986-1993, and equal to one for the remaining years. The idea behind the instrument is that the court ruling acts as an exogenous shock that pushed some acquirers that otherwise would not have used a termination fee into using one—possibly because the uncertainty about the legality of a termination fee was resolved. We also interact the Paramount dummy with other variables to account for the possibility that the court ruling affected how acquirer, target, and deal characteristics influence the use of a termination fee.

To implement the instrumental variable approach, we need to make some simplifying assumptions to equation (6).¹⁵ We assume that there is no different unobservable effect of the termination fee choice on price informativeness ($u_{0i} = u_{1i} = u_i$) and no differential impact of observable variables on price informativeness ($\beta_0 = \beta_1$). This brings us back to equation (3). The endogeneity concern is that private benefits contained in u_i are related to the termination fee dummy t_i . Instead of a linear probability model, we employ the procedure suggested in Wooldridge (2010, section 21.4) and Windmeijer and Santos Silva (1997). We start with a probit model for the termination fee choice that contains a vector of instruments, z_i , and the exogenous regressors of the price informative regression, x_i (see equation 8 below). The actual first stage regression (9) uses the fitted probabilities $\Phi(\hat{\theta}_0 + x_i\hat{\theta} + z_i\hat{\theta}_z)$ from the probit model (8) and the regressors from the price informativeness equation, x_i . The second-stage regression estimates the effect of using a termination fee, $(\alpha_1 - \alpha_0)$, where $\hat{t}_i$ are the predicted values from (9).

$$\text{stage 0: } t_i = 1[\theta_0 + x_i\theta + z_i\theta_z + \epsilon_i \geq 0] \quad (\text{probit}) \quad (8)$$

$$\text{stage 1: } t_i = \gamma_0 + x_i\gamma + \gamma_z\Phi(\hat{\theta}_0 + x_i\hat{\theta} + z_i\hat{\theta}_z) + v_i \quad (9)$$

$$\text{stage 2: } y_i = \beta_0 + x_i\beta + (\alpha_1 - \alpha_0)\hat{t}_i + u_i \quad (10)$$

Note that the probit model for the termination fee use does not need to be correctly specified, as it would have to be for consistency if the predicted probabilities from the probit model were directly used in the second stage (See Angrist and Krueger, 2001).¹⁶

¹⁵See Wooldridge (2010, section 21.4.1)

¹⁶What is needed is that the linear projection of t_i on x_i and $\Phi(\theta_0^* + x_i\theta^* + z_i\theta_z^*)$ actually depends on $\Phi(\theta_0^* + x_i\theta^* +$

A major concern with the IV approach is that it consistently estimates the effect of the termination fee use on price informativeness only if $u_{0i} = u_{1i}$, allowing us to neglect the term $t_i(u_{1i} - u_{0i})$.¹⁷ However, our discussion in Section 4.1 raises doubts about whether the impact of private benefits on price informativeness is unaffected by the presence of a termination fee. Private benefits are less likely to serve as a strong indicator of commitment if a merger already includes a sizable termination fee, implying $u_{0i} > u_{1i}$. Neglecting this, as the IV approach does, would assign too much impact to private benefits and underestimate the effect of a termination fee.

To overcome the limitation of the IV approach, we employ an endogenous switching model where the termination fee choice is modeled explicitly.¹⁸ It comes at the cost of having to impose a trivariate normality assumption for the error terms. The original model in equations (4) and (5) is augmented by:

$$t_i = 1[\theta_0 + x_i\theta + z_i\theta_z + \epsilon_i \geq 0] \quad (11)$$

$$(u_0, u_1, \epsilon)|x, z \sim \text{Multivariate Normal with}$$

$$\text{cov}(u_0, u_1, \epsilon) = \begin{bmatrix} \sigma_0^2 & \sigma_{01} & \sigma_{0\epsilon} \\ \sigma_{01} & \sigma_1^2 & \sigma_{1\epsilon} \\ \sigma_{0\epsilon} & \sigma_{1\epsilon} & 1 \end{bmatrix}$$

With these assumptions, an explicit expression for $E[u_{0i} + t_i(u_{1i} - u_{0i})|x_i, t_i]$ exists. The resulting terms can be added to equation (6) and the parameters of interest can then be consistently estimated.

$$E[y|w, x, z] = \alpha_0 + ATE \ w + x\beta_0 + w(x - \mu_x)(\beta_1 - \beta_0) \quad (12)$$

$$+ (1 - w)\sigma_{0\epsilon} \frac{\phi(q\theta)}{1 - \Phi(q\theta)} + w(\sigma_{1\epsilon} - \sigma_{0\epsilon}) \frac{\phi(q\theta)}{\Phi(q\theta)}$$

where $q = (x, z)'$ is the vector of outcome equation covariates and instruments. An additional

$z_i\theta_z^*$. θ_0^* , θ^* , and θ_z^* represent the plim of the ML estimator of the misspecified model (Wooldridge, 2010, p 940).

¹⁷See, e.g., Vella and Verbeek (1999) and Heckman (2010) for discussions of which restrictive assumptions one places implicitly on the economic mechanism that has generated the data if one uses the IV approach.

¹⁸(See Wooldridge, 2010, section 21.4.2). Applications of this method to finance can be found in Campa and Kedia (2002) and Fang (2005).

advantage of the endogenous switching model is that we can test the different mechanisms presented in 4.1 because we obtain estimates of $\sigma_{0\epsilon}$ and $\sigma_{1\epsilon}$. A natural test of endogeneity of the termination fee choice is to test whether $\sigma_{0\epsilon}$ and $\sigma_{1\epsilon}$ are jointly zero.

5 Results

5.1 Evidence from OLS on endogenous limits to arbitrage

We present the basic OLS regression of equation (7) as a benchmark and reference point for the later approaches. We start with testing hypothesis 1a and 1b and regress price informativeness, defined in equation (2), on the Termination Fee Dummy or Termination Fee Size and the set of independent variables from Panel B of Table 2. In addition we control for a trend in the average annual price informativeness across firms in the cross-section. The time-series pattern of this annual average resembles a quadratic trend until 2011. We deal with this by either including a quadratic trend plus year dummies for the years from 2012 to 2018 or by including year fixed effects. For all specifications we include industry fixed effects. Table 4 documents our findings.

The coefficient of the termination fee dummy is positive and statistically significant in both specifications (columns (1) and (3)). The point estimates of 0.113 (quadratic trend) and 0.123 (year fixed effects) represent the average increase in price informativeness if an acquirer termination fee is used. These estimates are equivalent to 15% and 17% of the sample average price informativeness of 0.73 and around 10% of its standard deviation as documented in Table 2. In column (2) and (4), Termination Fee Size is used as the independent variable of interest. The coefficient is again positive and highly statistically significant. Thus, price informativeness is increasing in the size of the acquirer termination fee. These two sets of finding supports our Hypotheses 1a and 1b.

As explained in section 4, the estimates are based on the assumption that for each merger with a termination there exists a comparable merger without a termination fee (and vice-versa for the ATE). To demonstrate that poor overlap is not a concern in our data, we present additional estimation results of the effect of using a termination fee on price informativeness in Table 5. Each panel shows results for different samples based on varying minimum and maximum cutoffs

for the propensity score. Notably, the OLS estimates from Equation 7 are nearly identical across the four samples. Besides OLS estimates, we also provide treatment effect estimates using inverse probability weighting, propensity score matching, and nearest neighbor matching. All of these approaches yield treatment effects of similar magnitude but also require that the unconfoundedness assumption holds, which we contest in section 4.1.

This initial series of strong support for hypotheses 1a and 1b is indicative of endogenous limits to arbitrage being present when no termination fee is used. However, the estimated coefficients are obtained from lumping together good and bad acquisitions and are akin to an average of the effects in those two samples. If endogenous limits to arbitrage are indeed the mechanism behind the effect of a termination fee on price informativeness, then we should observe a significant effect only among bad mergers (Hypothesis 2).

Ideally, we would test this hypothesis in a subsample of mergers where speculators have received a negative private signal about the merger quality. However, the nature of a private signal is that it is unobservable for all but the person receiving the signal. If there exist good proxies for signals about merger quality and the information is available for the acquirer when making the merger decision, the signal cannot be considered private.

Instead we focus on identifying mergers where the likelihood of a bad signal is higher than the likelihood of a good signal. To this end we rely on the acquirer abnormal announcement return. If the market reaction to the merger is negative on the announcement day, it is more likely that the merger is bad and speculators have more likely received a negative private signal about merger quality.

The variable Abnormal AR for acquirer i on day t is defined as the difference between realized return and normal return from the day before the announcement to the day after the announcement.¹⁹ We expect signals to informed traders about the deal quality to have been weaker if the

¹⁹Announcement returns are typically estimated using a two- or three-day window around the announcement. There are several reasons to follow this approach. One is that it captures the announcement returns even for deals that are announced after market close on the announcement date. Another is to capture the effect of initial trades on subsequent trading. Since we are interested in the initial signal received by the market on the announcement day and later measure the effect of subsequent trading, we use a one-day abnormal announcement return as a proxy for deal quality. The model for computing normal returns is estimated over the period -294 through -43 relative to then announcement date, with a minimum of 126 observations and using the Fama-French three-factor model. The abnormal return is then trimmed at the 1st and 99th percentile.

announcement return turned out to be close to zero and stronger if it turned out to be further away from zero. We therefore define mergers likely to have generated a bad private signal as deals with an abnormal announcement return below -0.02 . Deals likely to have generated a good private signal are deals with an abnormal announcement return above 0.02 .²⁰ We then test Hypothesis 2 by running the previous regressions of price informativeness on the termination fee and control variables for each of the two subsamples separately.

Table 6 provides the regression results for the year fixed effects specification. When dividing the sample using the abnormal announcement return as described above, the “Negative signal” subsample consist of 2,854 mergers and the “Positive signal” subsample has 2,919 mergers. We drop 6,746 observations with abnormal announcement returns between -0.02 and 0.02 from the analysis.

Under hypothesis 2, we would expect that the use of a termination fee has a positive significant effect on price informativeness in the negative-signal subsample, while there should be no effect in the positive-signal subsample. This is exactly what we find. For the negative-signal subsample, the coefficient estimate for the termination fee dummy is 0.15 with a t-statistic of 2.33. The estimated coefficient for the positive-signal subsample is much smaller and also not statistically different from zero.

We repeat the analysis with the termination fee size replacing the termination fee dummy and report results in panel B of Table 6. The point estimate for the subsample with a negative signal is positive and statistically significant at conventional levels. The point estimate in the subsample with a positive signal is less than one fifth of the estimate in the negative-signal subsample and statistically indistinguishable from zero.²¹

Taken together, these results provide strong support for the presence of endogenous limits to arbitrage and that a termination fee lifts these limits to arbitrage and produces more informative prices. However, there is the risk that the results are affected positively or negatively by an omitted

²⁰Results are qualitatively similar with lower cutoffs ranging from -0.025 through -0.005 and upper cutoffs from 0.005 through 0.025 . We report the results for the -0.01 and 0.01 cutoff combination in Table A2 in the Appendix.

²¹In Table A2 in the Appendix we show that results are qualitatively the same if we use cutoff -0.01 for the negative signal and 0.01 for the positive signal. This Table also shows that results does not change if we control for Trend and Trend squared.

variable like managerial private benefits.

5.2 Evidence from IV on endogenous limits to arbitrage

In this section, we take into account that unobservable variables such as private benefits could influence both the choice of using an acquirer termination fee and price informativeness. We employ the adjusted 2SLS procedure with the Paramount dummy and interaction terms of this dummy with deal, bidder, and target characteristics as instrumental variables (see section 4.2).

Table 7 presents the results of four different specifications for the initial probit model for the termination fee choice. The first two columns show the results of specifications without time-related variables. Column (3) shows the results when a quadratic trend is used and column (4) the results for a specification with year dummies. The termination fee use does not exhibit any particular time-series pattern (except for the sharp increase after the Paramount ruling which we exploit as IV) but price informativeness does. Since we include these time-related variables in the second stage regression, we also need to include them in the probit model.

The four different probit models show that the Paramount ruling had a strong and significant impact on the use of acquirer termination fees. After the paramount ruling, a termination fee is considerably more likely. For the termination fee users, the paramount ruling made fee usage seven times more likely. Columns (2) to (4) reveal that the ruling has also changed the way in which acquirer, target, and deal characteristics influence the decision to use a termination fee. The effect of deal characteristics has increased considerably in magnitude. The impact of deal size and acquirer size has risen by 60 to 70%.²² We also find that more highly levered bidders are more likely to include a termination fee after the ruling. A potential explanation is that the target is concerned about financing problems leading to a deal breakdown. Paying in cash is associated with a lower propensity to use a termination fee. This finding could be related to the financing situation of the acquirer, as well, but also to the availability of free cash flow that the management might use for its own benefit, e.g., for empire building. We will explore this agency issue in more detail in the

²²Note that the coefficients of deal size and bidder size are close in absolute terms but of opposite sign. This suggests that the difference between target size and bidder size is an important determinant of termination fee use and likely captures relative bargaining power.

next section. The size and significance of the interaction terms justify using both the paramount dummy and interaction terms between this dummy and deal characteristics as instruments.

Table 8 presents the results of the first stage regression (9). Its main finding is that the predicted probability of the probit model ($\Phi(\hat{\theta}_0 + x_i\hat{\theta} + z_i\hat{\theta}_z)$) is a highly significant instrument for the termination fee dummy. For all four specifications, the F-statistic from the Montiel-Pflueger robust weak instrument test (Montiel Olea and Pflueger, 2013) is very large compared to the 5%-critical value for an asymptotic 2SLS-estimator bias at the 5% threshold. Thus, we can reject the null hypothesis of a weak instrument. This is not very surprising, since the use of acquirer termination fees has become much more common after the Paramount ruling. When the predicted probability is added to the first stage regression, all other estimated coefficients are close to zero and statistically insignificant. This suggests that the probit model in Table 7 captures the main determinants of the termination fee choice.

Finally, the second-stage regression results using the Paramount instrument are reported in Table 9. Column (1) and column (2) represent second-stage results for models without time-trend variables. Column (3) reports the results for the quadratic trend model and column (4) the results for the model with year fixed effects. In all specifications, the termination fee dummy instrumented with the Paramount dummy and interaction terms is positively related to price informativeness, with point estimates between 0.33 and 0.45. These estimates are almost four times as large as the OLS estimates from Table 4 and amount to around 60% of the sample average and 40% of the standard deviation of our price informative measure. The finding that the IV estimate exceeds the OLS estimate is aligned with the economic idea from section 4.1 that the target managers and the informed traders perceive managerial merger motives as a sign of commitment by the bidder. This induces the informed traders to trade on their information and the target managers to go after other provisions in the merger agreement than an acquirer termination fee.

The clear finding that the inclusion of a termination fee causes acquirer prices to be more informative after the merger announcement is aligned with the endogenous-limits to arbitrage mechanism being present. To provide stronger support for its existence, we also test the finer predictions of this mechanism, namely, that the inclusion of a termination fee should only impact

price informativeness when speculators receive a bad signal about the merger (Hypothesis 2). We follow the same procedure as in Section 5.1 and define mergers likely to have generated a bad private signal as deals with an abnormal announcement return below -0.02 . Deals likely to have generated a good private signal are deals with an abnormal announcement return above 0.02 .

In Table 10, we report only the results for the 2SLS specification with year fixed effects. The results for the quadratic-trend specification can be found in table A3 in the Appendix. The first three columns under the headline “Negative signal” show the results of the augmented 2SLS procedure for bad mergers and the remaining three columns the results for good mergers. Again, the instruments have a strong effect on the use of a termination fee, with the effective F-statistics comfortably exceeding the 5%-critical value for a 2SLS estimator bias of at least 5%. The important finding is that the termination fee dummy has a highly significant effect on price informativeness in the bad merger sample while it is insignificant in the good merger sample. For the bad merger sample, the coefficient has further increased to 0.508.²³ This is exactly in line with the endogenous-limits to arbitrage theory, which states that informed traders would only be reluctant to trade on negative information.

Overall, the IV estimation results provide clear support for the presence of endogenous limits to arbitrage. However, we continue our analysis because our discussion on how private benefits might impact price informativeness indicates that an assumption underlying the IV approach may not hold in our sample.

5.3 Evidence from the endogenous switching model

Our concern with using the IV approach is that the impact of unobservables on price informativeness is assumed to be the same irrespective of whether a termination fee was used or not ($u_{1i} = u_{0i}$). This entails that the relationship between the unobservables affecting the termination fee choice (ϵ_i) and those affecting price informativeness is assumed to be the same for both the termination

²³If we use an announcement return of below -1% to create the negative-AR sample, then we find a coefficient of 0.507 for this subsample. The positive-AR sample, based on announcement returns above 1% yields an insignificant coefficient of 0.005.

fee and no termination fee sample. In terms of covariances, this translates to, $\sigma_{0\epsilon} = \sigma_{1\epsilon}$.²⁴ Yet, our discussion of potential sources of endogeneity suggests that private benefits likely have a stronger, more negative effect on price informativeness if no termination fee is used, i.e., $\sigma_{0\epsilon} < \sigma_{1\epsilon} \leq 0$. The endogenous switching model (4), (5), and (11) permits us to overcome this shortcoming of the IV approach because it allows for distinct covariances.

Table 11 contains the results for the endogenous switching model applied to the entire sample. We report the results for the specification with a quadratic trend and the specification with year fixed-effects. The column “Selection” contains the estimated coefficients for the probit model in equation (11) and the column “outcome” the results of the price informativeness equation. The results for the two specifications of the probit model are similar to the results for the probit model of the IV approach reported in Table 7. The estimated effect of the termination fee on price informativeness is larger than the coefficient obtained via IV. For the quadratic time trend specification (year fixed effects specification), we obtain a coefficient of 0.531 (0.557), which compares to an IV-estimate of 0.426 (0.448). These estimates correspond to more than 70% of the average of price informativeness and to around 50% of its standard deviation.

In panel B of Table 11, we report the estimates of the covariances between the error terms in the termination fee choice equation and the error terms in the price informativeness equation, ($\sigma_{0\epsilon}$ and $\sigma_{1\epsilon}$). They provide a couple of interesting insights. First, both $\sigma_{0\epsilon}$ and $\sigma_{1\epsilon}$ are clearly negative. These results hint at the same economic mechanism behind the termination fee choice as the bias of the OLS coefficient: Acquisitions motivated by private benefits of the bidder management are less likely to involve a termination fee because private benefits and termination fees are to some extent substitutes in their role as commitment signals. This commitment is also noticed by informed traders, who are willing to trade on their information. Second, $\sigma_{0\epsilon}$ is almost twice as large in absolute terms as $\sigma_{1\epsilon}$ indicating that private benefits are not as important as a sign of commitment if a termination fee is already used. Nevertheless, private benefits seem to provide a signal of bidder commitment above and beyond the use of a termination fee otherwise $\sigma_{1\epsilon}$ would be 0. This

²⁴Vella and Verbeek (1999) discuss the differences in assumptions between the IV approach and the control function approach (endogenous switching regression in our setting) and the importance of inspecting the economic mechanism giving rise to endogeneity in the first place.

difference explains why IV estimates, which are based on the assumption of equal covariances, are smaller. Finally, absence of endogeneity ($\sigma_{0\epsilon} = \sigma_{1\epsilon} = 0$) is strongly rejected for both specifications.

As in the two previous sections, we put the endogenous limits to arbitrage model to a tougher test and run the endogenous switching model on the high and low announcement return subsamples separately. We report the year-fixed effects specification in Table 12 and the quadratic trend specification in the Appendix in Table A4. The results are strikingly clear. For acquisitions that experienced a negative announcement return (negative signal), the inclusion of a termination fee leads to an increase in price informativeness of 0.832, which amounts to 75% of its standard deviation and is larger than its average. Within the positive announcement return sample, the inclusion of a termination fee does not have a significant effect on price informativeness. These findings are exactly in line with the workings of the endogenous limits to arbitrage mechanism.

Finally, we analyze the correlation structure of the error terms in the good and the bad acquisition subsamples. For the bad acquisition subsample, the findings for the covariances between the error terms in the termination fee choice equation and the error terms in the price informativeness equation are similar to the overall sample. However, in the positive abnormal return subsample, the correlation between the error terms is insignificant. Together with the insignificant termination fee dummy for this subsample, this strongly suggests that positively informed traders don't need a commitment signal to be willing to trade on their information²⁵. This is what we expect. The endogenous limits to arbitrage mechanism should only operate in the bad merger sample.

Table 13 summarizes the treatment effects estimated by the various models. Since the average treatment effect corresponds to the coefficient estimate of the termination fee dummy, which we already discussed, we focus on the treatment effect of the treated, ATT. For mergers with a termination fee, we find that using such a fee has increased price informativeness by 0.872 in the entire sample and by 1.099 in the sample of bad mergers, which is a further increase over the OLS and IV estimates. The latter implies that using a termination fee increases price informativeness by one standard deviation.

²⁵This findings does not allow us to conclude that the termination fee choice is unaffected by the private benefits of the management in that subsample. It implies that such unobservables are not correlated with unobservables in the price informativeness equation and do not cause an endogeneity problem.

The results of the endogenous switching model strongly support the endogenous limits to arbitrage theory. The coefficient of the termination fee dummy is highly significant and large in size, in particular when looking at acquisitions about the quality of which informed traders have likely received a negative signal. For those acquisitions, we find support for our endogeneity concern that is related to the presence of private benefits of the bidder management. In the good acquisition sample, neither the termination fee nor the potential source of endogeneity matter for price informativeness. This findings are exactly in line with the asymmetric nature of the endogenous limits to arbitrage mechanism.

6 Whose Trading Makes Prices Informative?

It is well known that merger arbitrageurs are trading in the acquirer around the merger announcement. Merger arbitrage involves buying the target's stock and shorting the stock of the acquirer in such a way that the short and long side perfectly match each other if and when the transaction closes. Merger arbitrageurs profit from a gap typically observed between the target stock price right after the announcement and the offered acquisition price. While they care about the merger success probability, they do not care about the quality of the merger per se. Regardless of the merger's quality, their strategy always involves shorting the bidder. Thus, their trading may or may not make prices informative in the same way the trading of informed traders does. For that reason, we check whether our earlier results hold in a subsample of mergers where merger arbitrageurs are absent. This will be the case if the target is not publicly listed.

Table 14 documents the relation between termination fee and price informativeness for the subsample of mergers with non-listed targets and for the subsample with listed targets. For the latter subsample, we additionally require that the payment was not made exclusively in cash. This ensures that any merger arbitrage trade, if it was made, always involved the bidder stock.

We present the estimates for coefficient of the termination fee dummy using our three different estimation techniques: OLS, the instrumental variable approach, and the endogenous switching approach. For the non-listed sample, the OLS estimates are similar in magnitude to the original

estimates but not significant. The IV estimates and the estimates of the endogenous switching model for this sample are highly significant and larger than the original estimates in Tables 9 and 11. This suggests that the endogeneity bias caused by the bidder management pursuing private benefits is more severe in the subsample of non-listed targets. The estimates for the non-listed sample tend to be larger than the estimates for the listed sample, indicating that the termination fee has a larger impact on price informativeness if merger arbitrageurs are absent.

Overall, the evidence in Table 14 is qualitatively similar to the evidence documented in Section 5. Thus, the support we find in favor of our hypotheses is not driven by the trading of merger arbitrageurs.

7 Conclusion

The theory of endogenous limits to arbitrage, as specified in Edmans, Goldstein, and Jiang (2015), suggests that the possibility of feedback from speculator trading, via information content of prices and order flow, to managerial actions causes speculators to be more reluctant to trade on their information. This leads to endogenously inefficient markets.

In this paper, we investigate whether such endogenous limits are at work in financial markets and measure their impact on price informativeness. Our empirical setting is trading and information flow around merger announcements. Endogenous limits to arbitrage can arise in this context if informed speculators are reluctant to trade on private negative information relevant to the merger, because they fear that the acquirer will cancel the transaction upon receiving this information. Our empirical investigation relies on the idea that prices should be more informative if the feedback loop is broken because canceling the deal entails a too high cost.

An acquirer termination fee, whereby the bidder has agreed to pay a fee to the target if the deal is canceled, can be such a cost that might shut down the endogenous limits to arbitrage mechanism if it exists. Consequently, if endogenous limits to arbitrage exist, bidder stock prices should be more informative when a termination fee is used.

As a preliminary step, we show that mergers with an acquirer termination fee are canceled

considerably less often than those without such a fee. We then estimate the effect of the use of a termination fee on price informativeness in three different ways: OLS, an instrumental variable approach, and an endogenous switching model. The results of all three methods support the presence of endogenous limits to arbitrage. Price informativeness improves significantly if an acquirer termination fee is used. More importantly, we find that the asymmetry inherent in the endogenous limits to arbitrage mechanism holds in the data. Only traders who have received a negative signal about the merger quality should be concerned about revealing their private information and the cancellation of the deal. Using positive and negative announcement day returns as a proxy for the likelihood of private positive or negative signals, we find a significant impact of termination fee use on price informativeness only in the subsample of negative signals.

Our results suggest that it is important to control for endogeneity and omitted variables. The inclusion of an acquirer termination fee in the merger agreement is a choice determined in the negotiations between the acquirer and the target, and merger motives of the bidder management are likely to play a crucial role. A large literature identifies managerial private benefits and empire building as merger motives. In such cases, the bidder management is more likely to complete the transaction even if the stock market reaction is negative, which should increase the willingness to trade on private information and thus enhance price informativeness. Such private benefits are also likely to affect the bargaining process leading to the merger agreement. Ex ante, we can think of different ways private benefits could affect the bargaining outcome, with some economic mechanisms making the inclusion of an acquirer termination fee more likely while others making it less likely. Since different mechanisms produce different biases in the OLS regression, the comparison between the OLS and the IV results allows us to shed some light on the mechanism at work.

In the landmark case *Paramount v. QVC Network*, the court ruled in favor of including a termination fee in merger agreements. This decision led to a strong and lasting increase in the usage of acquirer termination fees and altered how bidder, target, and deal characteristics affect the use of these fees. We employ a dummy variable equal to one after this ruling, along with interaction terms of this dummy with other characteristics as powerful and plausibly exogenous instrumental variables in a standard IV approach and an endogenous switching model. We consider

the latter method better suited to the economic mechanisms suspected of causing the endogeneity problem. The resulting coefficient estimates are much larger than the OLS estimates. The increase suggests that the target management understands the opportunistic merger motives of the bidder management, is less concerned with the transaction failing, and uses its bargaining power to secure other concessions than a termination fee in the bargaining leading to the merger agreement.

Finally, we investigate whether the difference in price informativeness is due to the trading behavior of merger arbitrageurs, who are concerned with the likelihood of deal completion rather than the quality of the merger itself. We find that the effect is present and even more pronounced in the sample of mergers with non-listed targets, where the merger arbitrage trade is not feasible.

Overall, our results suggest a sizable impact of endogenous limits to arbitrage. The increase in price informativeness brought about by using a termination fee amounts to more than average price informativeness in the data and 74% of its standard deviation. In the sample of non-listed firms it even amounts to an increase that corresponds to 175% of its mean and 116% of its standard deviation.

The implication of our findings is an inevitable welfare loss: If the acquirer in a bad merger has not tied its hands through a termination fee, endogenous limits to arbitrage make prices less informative and an inefficient merger is completed. If the acquirer has tied its hands, prices are informative but because of the commitment an inefficient merger is completed.

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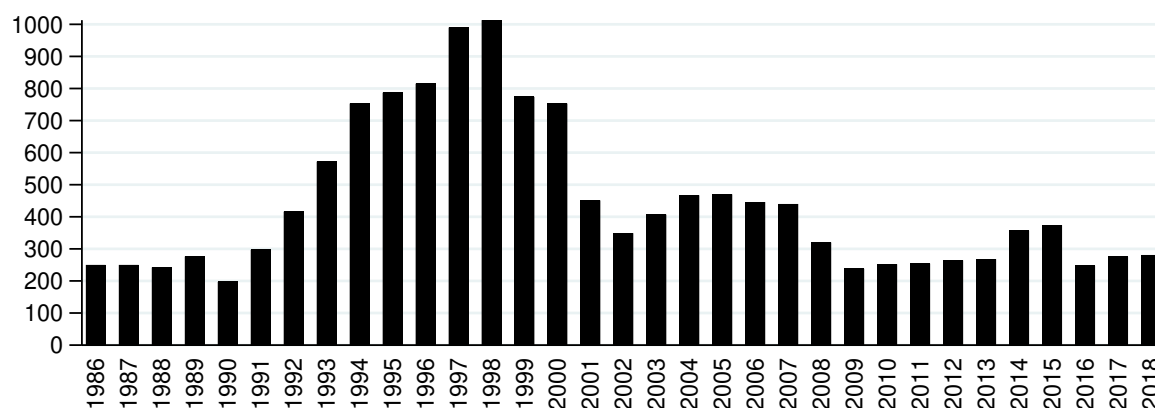
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Figure 1
Number of mergers and number of mergers where the acquirer has signed a termination agreement, 1986–2018

The sample consists of 14,545 mergers announced between 1986 and 2018. There are 1,327 mergers with an acquirer termination agreement. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The figure reflects the sample selection described in Section 3.1 and documented in Table 1.

A. Number of mergers



B. Number of mergers with acquirer termination agreement

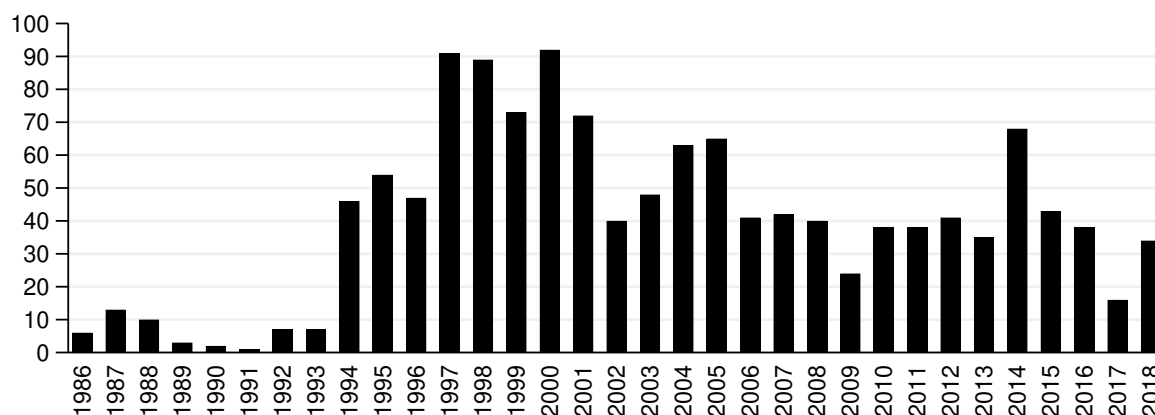


Table 1
Sample selection

The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). PERMNO is the permanent security identifier for security information provided by the Center for Research in Security Prices (CRSP). GVKEY is a permanent company identifier for data provided by Compustat. Relative Deal Size is transaction value divided by bidder market capitalization 42 days prior to the deal announcement date.

Sample selection filters	Num. obs.
Databases: US and Non-US deals + Date announced: 1.1.1986–31.12.2018 + Acquirer Nation: US	
+ Acquirer Public Status: P + Deal value: Where information is available + Type of Deal: Merger	22,254
Match Bidder to PERMNO in CRSP and GVKEY in Compustat	18,362
CRSP Bidder share codes 10 or 11 + Deal ann. date within time-series of CRSP daily returns	17,550
Keeping only the first announcement in a bidding contest	17,454
Non-missing bidder market capitalization and total assets prior to announcement date	16,258
Relative Deal Size > 1%	14,817
Dropping utilities	14,545
Exogenous variables (covariates) available	12,159

Table 2
Descriptive statistics

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The column named “Diff.” reports the differences in means between samples with Termination Fee D equal to zero and Termination Fee D equal to one. The t-value in the last column is the difference in means divided by the standard error of the difference. All variables are defined in Appendix Table A1.

Variable	Full sample				Termination Fee D = 0		Termination Fee D = 1		Diff.	t-val.
	N	Mean	Median	Std.	N	Mean	N	Mean		
A. Termination fee and dependent variables										
Term fee D	12519	0.07	0.00	0.25						
Term Fee Size	12519	0.00	0.00	0.01	11691	0.00	828	0.03	-0.03	-113.2
Price Informativeness	12519	0.73	0.72	1.12	11691	0.74	828	0.69	0.04	1.04
Withdraw	12159	0.09	0.00	0.29	11336	0.09	823	0.09	0.00	0.31
B. Covariates										
Inst. Ownership	12519	0.46	0.45	0.30	11691	0.45	828	0.52	-0.07	-6.66
Breadth of Ownership	12519	0.06	0.03	0.08	11691	0.06	828	0.06	0.00	-1.11
Ln Deal Value	12519	4.39	4.23	2.00	11691	4.27	828	6.16	-1.89	-27.09
Cashonly	12519	0.29	0.00	0.46	11691	0.30	828	0.15	0.15	9.43
Unsolicited	12519	0.04	0.00	0.18	11691	0.04	828	0.03	0.01	1.04
Target is Public	12519	0.46	0.00	0.50	11691	0.44	828	0.80	-0.36	-20.61
Ln Market Cap	12519	6.36	6.36	2.03	11691	6.34	828	6.66	-0.32	-4.37
Market to book	12519	3.40	2.22	3.71	11691	3.41	828	3.24	0.17	1.29
Leverage	12519	0.22	0.16	0.22	11691	0.22	828	0.22	0.00	0.21
Past one-year CAR	12519	-0.01	-0.01	0.65	11691	-0.01	828	-0.06	0.06	2.37
Volatility	12519	0.48	0.39	0.29	11691	0.48	828	0.48	0.00	-0.16
Lagged price inf.	12519	1.21	1.19	1.22	11691	1.22	828	1.00	0.23	5.22
Normal Volume	12519	11.67	11.72	1.99	11691	11.63	828	12.25	-0.62	-8.73
Runup	12519	0.00	0.00	0.19	11691	0.00	828	0.02	-0.02	-3.11
Announcement AR	12519	0.00	0.00	0.05	11691	0.00	828	-0.01	0.01	5.96
Same Industry	12519	0.77	1.00	0.42	11691	0.77	828	0.81	-0.04	-2.94

Table 3
The probability of canceling a transaction

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The dependent variable is Withdrawn: A dummy variable equal to one if SDC status is “Withdrawn” and equal to zero if SDC status is “Completed.” The regressors “1st quartile” to “4th quartile” are dummy variables equal to one if the termination fee size lies in the respective quartiles. The coefficients are estimated using Probit and standard errors are robust to heteroskedasticity. Parentheses contain z-values. All variables are defined in Appendix Table A1.

Variable	Dependent variable: Withdrawn		
	(1)	(2)	(3)
1 st quartile	0.048 (0.38)		
2 nd quartile	−0.404 (−2.81)		
3 rd quartile	−0.349 (−2.77)		
4 th quartile	−0.165 (−1.46)		
Term fee D		−0.296 (−3.86)	−0.418 (−4.05)
Term fee size			3.952 (1.88)
Inst. Ownership	0.106 (1.18)	0.108 (1.20)	0.106 (1.18)
Breadth of Ownership	0.640 (1.68)	0.640 (1.68)	0.631 (1.66)
Ln Deal Value	0.170 (10.03)	0.172 (10.19)	0.170 (10.07)
Cashonly	−0.163 (−3.45)	−0.164 (−3.47)	−0.167 (−3.54)
Unsolicited	1.685 (22.76)	1.681 (22.72)	1.683 (22.73)
Target is Public	0.592 (12.96)	0.592 (13.01)	0.593 (13.03)
Ln Firm Value	−0.274 (−9.85)	−0.275 (−9.92)	−0.273 (−9.82)
Market to book	0.004 (0.68)	0.004 (0.68)	0.004 (0.70)
Leverage	0.491 (4.54)	0.497 (4.61)	0.486 (4.49)
Past one-year CAR	−0.030 (−1.08)	−0.030 (−1.10)	−0.029 (−1.05)
Volatility	0.128 (1.33)	0.129 (1.34)	0.124 (1.29)
Lagged price inf.	0.071 (3.82)	0.071 (3.82)	0.071 (3.85)
Normal volume	0.065 (3.32)	0.065 (3.33)	0.065 (3.33)
Runup	−0.295 (−3.02)	−0.294 (−3.02)	−0.296 (−3.04)
Announcement AR	−0.268 (−0.71)	−0.264 (−0.70)	−0.251 (−0.66)
Same Industry	−0.106 (−2.39)	−0.105 (−2.38)	−0.106 (−2.41)
Constant	−1.284 (−5.81)	−1.287 (−5.83)	−1.290 (−5.85)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Pseudo R^2	0.235	0.235	0.236
Number of observations	12,159	12,159	12,159

Table 4
Price informativeness and acquirer termination fees

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). Coefficients are estimated using OLS and standard errors are robust to heteroskedasticity. T-statistics in parentheses. All variables are defined in Appendix Table A1.

Variable	Dependent variable: Price informativeness			
	(1)	(2)	(3)	(4)
Termination Fee D	0.113 (3.02)		0.123 (3.30)	
Termination Fee Size		4.173 (4.74)		4.306 (4.85)
Inst. Ownership	-0.214 (-5.18)	-0.214 (-5.18)	-0.230 (-5.55)	-0.230 (-5.55)
Breadth of Ownership	0.493 (2.76)	0.494 (2.76)	0.423 (2.39)	0.423 (2.39)
Ln Deal Value	0.034 (4.32)	0.032 (4.15)	0.036 (4.61)	0.035 (4.47)
Cashonly	0.029 (1.37)	0.028 (1.33)	0.038 (1.81)	0.036 (1.75)
Unsolicited	0.066 (1.43)	0.068 (1.47)	0.068 (1.48)	0.069 (1.51)
Target is Public	-0.045 (-2.25)	-0.044 (-2.19)	-0.043 (-2.14)	-0.041 (-2.06)
Ln Market Cap	-0.132 (-10.2)	-0.129 (-10.1)	-0.130 (-9.84)	-0.128 (-9.72)
Market to Book	-0.004 (-1.59)	-0.004 (-1.57)	-0.004 (-1.64)	-0.004 (-1.61)
Leverage	0.217 (4.18)	0.207 (3.99)	0.223 (4.29)	0.213 (4.09)
Past one-year CAR	-0.048 (-3.53)	-0.047 (-3.48)	-0.053 (-3.90)	-0.052 (-3.84)
Volatility	-0.126 (-2.63)	-0.129 (-2.69)	-0.123 (-2.34)	-0.126 (-2.40)
Lagged price inf.	0.195 (21.4)	0.195 (21.5)	0.190 (20.5)	0.190 (20.5)
Normal Volume	-0.043 (-4.47)	-0.044 (-4.52)	-0.043 (-4.42)	-0.044 (-4.47)
Runup	-0.199 (-4.09)	-0.200 (-4.13)	-0.209 (-4.32)	-0.211 (-4.36)
Announcement AR	0.203 (1.06)	0.201 (1.06)	0.136 (0.71)	0.133 (0.70)
Same Industry	-0.053 (-2.39)	-0.053 (-2.39)	-0.054 (-2.45)	-0.054 (-2.44)
Constant	1.936 (20.3)	1.939 (20.4)	1.884 (17.1)	1.886 (17.1)
Trend	0.047 (8.18)	0.047 (8.19)		
Trend squared	-0.003 (-12.9)	-0.003 (-12.9)		
Year fixed effects	2012-2018	2012-2018	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
R^2	0.279	0.280	0.289	0.289
Number of observations	12,519	12,519	12,519	12,519

Table 5
The effect of bidder termination provisions on price informativeness - Treatment effects assuming unconfoundedness

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The propensity score is derived from the probit models reported in Table 7. Column (3) contains the model using a quadratic trend and column (4) the model with year fixed effects. Standard errors of the average treatment effect (ATE) and the treatment effect on the treated (ATT) are robust to heteroskedasticity. T-statistics in parentheses. All variables are defined in Appendix Table A1.

	Trend		Fixed effects	
	ATE	ATET	ATE	ATET
Propensity score $\in (0.001, 0.999)$, N=9944/10236				
OLS (equation 7)	0.105 (2.74)	0.105 (2.74)	0.113 (2.93)	0.113 (2.93)
Inverse Probability Weighting	0.090 (1.01)	0.027 (0.59)	0.130 (1.64)	0.015 (0.32)
Propensity Score Matching	0.049 (0.52)	0.040 (0.70)	0.141 (1.54)	0.043 (0.68)
Nearest Neighbor Matching	0.129 (1.86)	0.165 (3.42)	0.122 (2.12)	0.141 (2.63)
B. Propensity score $\in (0.01, 0.99)$, N=6708/6882				
OLS (equation 7)	0.101 (2.54)	0.101 (2.54)	0.117 (2.92)	0.117 (2.92)
Inverse Probability Weighting	0.182 (1.85)	0.045 (1.01)	0.242 (2.59)	0.027 (0.55)
Propensity Score Matching	0.115 (1.91)	0.107 (1.77)	0.155 (2.29)	0.067 (1.06)
Nearest Neighbor Matching	0.102 (1.57)	0.148 (2.96)	0.097 (1.81)	0.130 (2.32)
C. Propensity score $\in (0.05, 0.95)$, N=3740/3908				
OLS (equation 7)	0.108 (2.49)	0.108 (2.49)	0.120 (2.78)	0.120 (2.78)
Inverse Probability Weighting	0.103 (1.71)	0.063 (1.29)	0.144 (2.69)	0.023 (0.39)
Propensity Score Matching	0.110 (1.71)	0.131 (2.00)	0.175 (2.94)	0.036 (0.56)
Nearest Neighbor Matching	0.095 (1.57)	0.155 (2.80)	0.071 (1.30)	0.132 (2.12)
D. Propensity score $\in (0.1, 0.9)$, N=2473/2540				
OLS (equation 7)	0.118 (2.48)	0.118 (2.48)	0.124 (2.65)	0.124 (2.65)
Inverse Probability Weighting	0.143 (2.47)	0.079 (1.55)	0.123 (2.45)	0.043 (0.75)
Propensity Score Matching	0.144 (2.34)	0.039 (0.58)	0.110 (1.90)	0.081 (1.12)
Nearest Neighbor Matching	0.108 (1.73)	0.183 (2.98)	0.075 (1.29)	0.172 (2.52)

Table 6
Price informativeness and acquirer termination fees using subsamples selected on
acquirer announcement day abnormal return

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The column named “Negative signal” contains all observations with acquirer Announcement AR below -0.02 . The column named “Positive signal” contains all observations with acquirer Announcement AR above 0.02 . Coefficients are estimated using OLS and standard errors are robust to heteroskedasticity. T-statistics in parentheses. All variables are defined in Appendix Table A1.

	Dependent variable: Price informativeness	
	Negative signal	Positive signal
A. Termination Fee Dummy		
Term fee D	0.151 (2.33)	0.067 (0.91)
Inst. Ownership	-0.271 (-3.14)	-0.185 (-2.16)
Breadth of Ownership	0.425 (1.26)	0.620 (1.39)
Ln Deal Value	0.019 (1.09)	-0.003 (-0.18)
Cashonly	0.036 (0.77)	0.102 (2.22)
Unsolicited	0.095 (1.11)	0.060 (0.51)
Target is Public	-0.092 (-2.03)	0.025 (0.57)
Ln Market Cap	-0.123 (-4.69)	-0.100 (-3.88)
Market to Book	-0.004 (-0.79)	-0.009 (-1.72)
Leverage	0.216 (2.02)	0.140 (1.21)
Past one-year CAR	-0.050 (-2.04)	-0.052 (-2.11)
Volatility	-0.182 (-1.96)	-0.049 (-0.48)
Lagged price inf.	0.149 (7.67)	0.129 (6.53)
Normal Volume	-0.041 (-2.14)	-0.067 (-3.59)
Runup	-0.091 (-1.01)	-0.296 (-3.38)
Announcement AR	-0.580 (-1.01)	0.648 (1.39)
Same Industry	-0.001 (-0.02)	-0.094 (-2.18)
Constant	2.020 (7.69)	2.451 (8.89)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
R^2	0.269	0.257
Number of obs.	2,854	2,919
B. Termination Fee Size		
Termination Fee Size	5.442 (3.50)	0.958 (0.62)
Other Control var.	Yes	Yes
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
R^2	0.271	0.257
Number of obs.	2,854	2,919

Table 7
Probit Model for termination fee choice

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The dependent variable is the termination fee dummy. The coefficients are estimated using Probit and standard errors are robust to heteroskedasticity. Parentheses contain z-values. All variables are defined in Appendix Table A1.

	(1)	(2)	(3)	(4)
Param dummy	0.946 (8.83)	1.377 (5.22)	0.902 (3.63)	1.544 (3.62)
Param $\times$ Deal size		0.287 (4.31)	0.260 (3.79)	0.286 (4.13)
Param $\times$ Cashonly		-1.118 (-6.10)	-1.304 (-6.74)	-1.183 (-5.89)
Param $\times$ Bidder size		-0.279 (-4.57)	-0.264 (-4.32)	-0.274 (-4.54)
Param $\times$ Bidder lev.		0.746 (1.83)	0.661 (1.58)	0.701 (1.71)
Param $\times$ Runup		-0.573 (-2.24)	-0.512 (-2.06)	-0.646 (-2.36)
Inst. Ownership	0.104 (1.10)	0.112 (1.17)	0.085 (0.88)	0.103 (1.06)
Breadth of Ownership	-1.043 (-2.40)	-1.106 (-2.51)	-0.357 (-0.81)	-0.291 (-0.65)
Ln Deal Value	0.560 (26.21)	0.298 (4.67)	0.323 (4.89)	0.305 (4.60)
Cashonly	-0.305 (-5.43)	0.723 (4.13)	0.833 (4.50)	0.711 (3.68)
Unsolicited	-0.855 (-6.99)	-0.838 (-6.76)	-0.870 (-6.94)	-0.893 (-7.10)
Target is Public	0.607 (11.57)	0.599 (11.17)	0.648 (11.70)	0.645 (11.54)
Ln Market Cap	-0.494 (-15.48)	-0.239 (-3.74)	-0.233 (-3.62)	-0.248 (-3.84)
Market to Book	-0.004 (-0.64)	-0.004 (-0.53)	0.001 (0.16)	0.002 (0.25)
Leverage	0.543 (4.18)	-0.160 (-0.40)	-0.049 (-0.12)	-0.082 (-0.20)
Past one-year CAR	-0.047 (-1.43)	-0.047 (-1.42)	-0.056 (-1.68)	-0.042 (-1.27)
Volatility	-0.140 (-1.21)	-0.154 (-1.29)	-0.021 (-0.18)	-0.149 (-1.12)
Lagged price inf.	-0.047 (-2.15)	-0.046 (-2.11)	0.001 (0.05)	0.006 (0.24)
Normal Volume	0.057 (2.49)	0.059 (2.59)	0.009 (0.38)	0.022 (0.91)
Runup	-0.121 (-1.07)	0.419 (1.85)	0.361 (1.67)	0.493 (2.01)
Announcement AR	-0.130 (-0.32)	-0.026 (-0.06)	-0.199 (-0.48)	-0.112 (-0.27)
Same Industry	0.085 (1.55)	0.091 (1.66)	0.097 (1.73)	0.089 (1.58)
Trend			0.076 (2.55)	
Trend squared			-0.001 (-1.20)	
constant	-3.162 (-12.14)	-3.602 (-10.14)	-3.798 (-9.94)	-3.546 (-7.66)
Year FE	No	No	2012-2018	Yes
Industry FE	Yes	Yes	Yes	Yes
Pseudo R^2	0.297	0.306	0.321	0.324
N	12519	12519	12519	12274

Table 8
Price informativeness using the Paramount dummy and interaction terms as
instruments for acquirer termination fee: First stage regression

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The dependent variable is the termination fee dummy. $\Phi(\hat{\theta}_0 + x_i\hat{\theta} + z_i\hat{\theta}_z)$ is the predicted probability of using a termination fee using the estimates of the respective probit models in table 7. The coefficients are estimated using 2SLS and standard errors are robust to heteroskedasticity. Parentheses contain t-values. The row “5% critical value” contains the 5% critical values for a relative bias (IV bias divide by worst case OLS bias) of 5%. The weak IV tests are performed using the Stata function weakivtest. All variables are defined in Appendix Table A1.

	(1)	(2)	(3)	(4)
$\Phi(\hat{\theta}_0 + x_i\hat{\theta} + z_i\hat{\theta}_z)$	1.067 (20.27)	1.020 (18.43)	1.024 (20.28)	1.031 (20.85)
Param dummy	-0.002 (-0.51)	-0.007 (-0.60)	-0.007 (-0.67)	-0.014 (-0.53)
Param $\times$ Deal size		-0.001 (-0.37)	-0.002 (-0.48)	-0.002 (-0.56)
Param $\times$ Cashonly		-0.001 (-0.08)	0.000 (-0.01)	0.000 (0.01)
Param $\times$ Bidder size		0.002 (0.66)	0.002 (0.73)	0.002 (0.83)
Param $\times$ Bidder lev.		-0.009 (-0.54)	-0.008 (-0.49)	-0.007 (-0.41)
Param $\times$ Runup		0.000 (0.02)	0.000 (-0.02)	0.000 (0.01)
Inst. Ownership	0.002 (0.20)	0.003 (0.26)	0.004 (0.39)	0.004 (0.41)
Breadth of Ownership	0.011 (0.27)	0.003 (0.06)	0.003 (0.08)	0.001 (0.03)
Ln Deal Value	-0.004 (-1.60)	0.000 (-0.12)	0.000 (-0.14)	0.000 (-0.19)
Cashonly	-0.001 (-0.31)	-0.001 (-0.12)	-0.001 (-0.10)	-0.001 (-0.08)
Unsolicited	0.004 (0.31)	-0.002 (-0.20)	-0.001 (-0.10)	0.000 (-0.04)
Target is Public	-0.004 (-0.74)	-0.001 (-0.11)	0.000 (-0.04)	0.000 (-0.04)
Ln Market Cap	0.003 (1.05)	0.000 (-0.06)	0.000 (-0.07)	0.000 (-0.01)
Market to Book	0.000 (0.12)	0.000 (0.03)	0.000 (0.02)	0.000 (-0.03)
Leverage	-0.007 (-0.58)	0.002 (0.19)	0.002 (0.13)	0.001 (0.05)
Past one-year CAR	0.000 (0.14)	0.000 (0.05)	0.000 (0.13)	0.000 (0.09)
Volatility	0.000 (0.04)	0.000 (-0.01)	0.000 (0.02)	0.001 (0.07)
Lagged price inf.	0.000 (0.07)	0.000 (0.02)	0.000 (0.05)	0.000 (0.08)
Normal Volume	0.000 (0.12)	0.000 (0.15)	0.000 (0.10)	0.000 (0.09)
Runup	-0.002 (-0.22)	-0.002 (-0.25)	-0.002 (-0.28)	-0.003 (-0.27)
Announcement AR	0.007 (0.12)	0.002 (0.03)	0.002 (0.04)	0.006 (0.09)
Same Industry	-0.001 (-0.15)	0.000 (-0.06)	0.000 (0.00)	0.000 (-0.08)
Trend			0.000 (0.21)	
Trend squared			0.000 (-0.23)	
constant	-0.008 (-0.38)	-0.004 (-0.16)	-0.004 (-0.19)	-0.003 (-0.11)
Year FE	No	No	2012-2018	Yes
Industry FE	Yes	Yes	Yes	Yes
R^2	0.208	0.212	0.227	0.233
F-stat weak instr	369.6	231.7	256.1	285.2
5% critical value	28.210	31.23	30.30	30.57
N	12519	12519	12519	12274

Table 9
Price informativeness using the Paramount dummy and interaction terms as
instruments for acquirer termination fee: Second stage regression

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The dependent variable is price informativeness. The coefficients are estimated using 2SLS and standard errors are robust to heteroskedasticity. Parentheses in the columns contain z-values.. All variables are defined in Appendix Table A1.

	(1)	(2)	(3)	(4)
Term fee D	0.329 (2.61)	0.322 (2.60)	0.426 (3.61)	0.448 (3.86)
Inst. Ownership	-0.307 (-7.41)	-0.307 (-7.41)	-0.216 (-5.22)	-0.233 (-5.61)
Breadth of Ownership	1.274 (7.24)	1.272 (7.23)	0.531 (2.95)	0.490 (2.71)
Ln Deal Value	0.004 (0.41)	0.005 (0.45)	0.017 (1.69)	0.018 (1.78)
Cashonly	-0.050 (-2.33)	-0.050 (-2.34)	0.044 (2.02)	0.051 (2.36)
Unsolicited	0.087 (1.80)	0.086 (1.78)	0.097 (2.04)	0.102 (2.15)
Target is Public	-0.019 (-0.91)	-0.019 (-0.90)	-0.063 (-2.99)	-0.061 (-2.88)
Ln Market Cap	-0.087 (-6.31)	-0.088 (-6.34)	-0.119 (-8.75)	-0.120 (-8.61)
Market to Book	0.001 (0.40)	0.001 (0.40)	-0.004 (-1.56)	-0.004 (-1.45)
Leverage	0.217 (4.15)	0.217 (4.15)	0.201 (3.85)	0.212 (4.03)
Past one-year CAR	-0.057 (-4.20)	-0.057 (-4.21)	-0.046 (-3.36)	-0.050 (-3.63)
Volatility	0.002 (0.04)	0.002 (0.04)	-0.125 (-2.61)	-0.137 (-2.73)
Lagged price inf.	0.246 (27.33)	0.246 (27.33)	0.195 (21.38)	0.191 (20.49)
Normal Volume	-0.093 (-9.61)	-0.093 (-9.61)	-0.044 (-4.58)	-0.042 (-4.29)
Runup	-0.208 (-4.24)	-0.208 (-4.24)	-0.198 (-4.08)	-0.202 (-4.16)
Announcement AR	0.185 (0.95)	0.184 (0.95)	0.239 (1.25)	0.199 (1.04)
Same Industry	-0.056 (-2.47)	-0.056 (-2.46)	-0.056 (-2.53)	-0.064 (-2.86)
Trend			0.045 (7.79)	
Trend squared			-0.003 (-12.76)	
constant	2.202 (23.03)	2.201 (23.03)	1.953 (20.50)	1.902 (17.18)
Year FE	No	No	2012-2018	Yes
Industry FE	Yes	Yes	Yes	Yes
R^2	0.252	0.252	0.275	0.287
N	12519	12519	12519	12274

Table 10
Price informativeness using the Paramount dummy and interaction terms as
instruments for acquirer termination fee using sub-samples selected on acquirer
announcement day abnormal return

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The columns named “Negative signal” contain all observations with acquirer Announcement AR below -0.02. The columns named “Positive signal” contain all observations with acquirer Announcement AR above 0.02. The coefficients are estimated using 2SLS and standard errors are robust to heteroskedasticity. Parentheses in the columns named “First stage” contain t-values. Parentheses in the columns named “Probit” and “Second stage” contain z-values. The rows labeled “Effective F-statistic” contains the F-statistic for the Montiel-Pflueger robust weak instrument test. The row “5% critical value” contains the 5% critical values for a relative bias (IV bias divided by worst case OLS bias) of 5%. The weak IV tests are performed using the Stata function weakivtest. All variables are defined in Appendix Table A1.

	Negative signal			Positive signal		
	Probit	1st stage	2nd stage	Probit	1st stage	2nd stage
Term fee D			0.508 (2.82)			−0.109 (−0.51)
$\Phi(\hat{\theta}_0 + x_i\hat{\theta} + z_i\hat{\theta}_z)$		1.087 (14.68)			0.979 (12.11)	
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
pseudo R^2/R^2	0.335	0.290	0.261	0.324	0.268	0.264
Effect. F-stat.		100.900			77.42	
5% critical value		29.520			30.220	
Observations	2757	2757	2757	2729	2729	2729

Table 11
Endogenous switching model

The sample consists of 14,545 mergers announced between 1986 and 2018. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The estimated model is equations (4), (5), and (11). Parentheses contain z-values. Square brackets contain 95% confidence intervals. All variables are defined in Appendix Table A1.

Variable	Quadratic trend		Year fixed effects	
	Selection: Termination Fee D	Outcome: Price informativ	Selection: Termination Fee D	Outcome: Price informativ
A. Treatment effect model				
Term fee D		0.531 (3.500)		0.557 (3.860)
Param dummy	0.938 (3.900)		1.426 (3.100)	
Param $\times$ Deal size	0.268 (4.020)		0.287 (4.160)	
Param $\times$ Cashonly	-1.165 (-5.430)		-1.042 (-4.710)	
Param $\times$ Bidder size	-0.278 (-5.020)		-0.281 (-4.940)	
Param $\times$ Bidder leverage	0.690 (1.650)		0.780 (1.790)	
Param $\times$ Runup	-0.410 (-1.370)		-0.736 (-2.630)	
Other Controls	Yes	Yes	Yes	Yes
Year fixed effects	No	No	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Number of observations	12,519	12,519	12,519	12,519
B. Model error correlations				
ρ_0	-0.435 [-0.703, -0.059]		-0.469 [-0.733, -0.082]	
ρ_1	-0.219 [-0.370, -0.057]		-0.223 [-0.366, -0.070]	
σ_0	0.969 [0.946, 0.992]		0.960 [0.936, 0.984]	
σ_1	0.984 [0.929, 1.043]		0.973 [0.917, 1.032]	
$\sigma_{\epsilon 0}$	-0.421 [-0.749, -0.093]		-0.450 [-0.779, -0.121]	
$\sigma_{\epsilon 1}$	-0.216 [-0.374, -0.058]		-0.217 [-0.365, -0.069]	
Wald test: $\rho_0 = \rho_1 = 0$	$Pr(\chi^2_2 > \hat{\chi}^2_2 = 8.040) = 0.018$		$Pr(\chi^2_2 > \hat{\chi}^2_2 = 9.290) = 0.010$	

Table 12
Endogenous switching model using sub-samples selected on acquirer announcement
day abnormal return: Year Fixed Effects specification

The sample consists of 14,545 mergers announced between 1986 and 2018. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The columns named “Negative signal” contain all observations with acquirer Announcement AR below -0.02. The columns named “Positive signal” contain all observations with acquirer Announcement AR above 0.02. The estimated model is equations (4), (5), and (11). Parentheses contain z-values. Square brackets contain 95% confidence intervals. All variables are defined in Appendix Table A1.

Variable	Negative signal		Positive signal	
	Selection: Termination Fee D	Outcome: Price informativ	Selection: Termination Fee D	Outcome: Price informativ
A. Treatment effect model				
Term fee D		0.832 (4.010)		-0.114 (-0.430)
Param dummy	1.179 (1.590)		6.983 (5.760)	
Param × Deal size	0.347 (2.930)		0.080 (0.440)	
Param × Cashonly	-0.883 (-2.190)		-1.700 (-3.370)	
Param × Bidder size	-0.394 (-4.210)		-0.241 (-1.720)	
Param × Bidder leverage	0.248 (0.300)		4.410 (2.060)	
Param × Runup	-1.129 (-2.430)		-1.112 (-1.840)	
Other Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Number of observations	2,854	2,854	2,919	2,919
B. Model error correlations				
ρ_0	-0.623 [-0.851, -0.197]		0.204 [-0.094, 0.468]	
ρ_1	-0.366 [-0.567, -0.123]		0.0991 [-0.256, 0.431]	
σ_0	0.956 [0.909, 1.006]		0.959 [0.932, 0.988]	
σ_1	1.001 [0.897, 1.118]		0.966 [0.864, 1.080]	
$\sigma_{\epsilon 0}$	-0.596 [-0.930, -0.261]		0.196 [-0.082, 0.473]	
$\sigma_{\epsilon 1}$	-0.366 [-0.613, -0.120]		0.0957 [-0.253, 0.445]	
Wald test: $\rho_0 = \rho_1 = 0$	$Pr(\chi^2_2 > \hat{\chi}^2_2 = 11.690) = 0.003$		$Pr(\chi^2_2 > \hat{\chi}^2_2 = 1.84) = 0.398$	

Table 13
Average treatment effects

The sample consists of 14,545 mergers announced between 1986 and 2018. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The estimated model is equations (4) through (??). For all covariates, except lagged price informativeness, the parameter estimates for the outcome models in equation (4) and (5) are restricted to be identical. See Table ?? for parameter estimates using the full sample and using the sample with $Pr(Term.Fee) > 0.01$.

Model	Number of obs.	ATE	ATT
A. OLS			
Full Sample	12,519	0.123 (3.30)	0.123 (3.30)
Negative Signal	2,854	0.151 (2.33)	0.151 (2.33)
Positive Signal	2,919	0.067 (0.91)	0.067 (0.91)
B. IV			
Full Sample	12519	0.448 (3.86)	0.448 (3.86)
Negative Signal	2757	0.508 (2.82)	0.508 (2.82)
Positive Signal	2729	-0.109 (-0.51)	-0.109 (-0.51)
C. Endogenous Switching Model			
Full Sample	12519	0.557 (3.861)	0.872 (3.041)
Negative Signal	2854	0.832 (4.012)	1.099 (3.831)
Positive Signal	2919	-0.114 (-0.431)	-0.236 (-0.999)

Table 14
Price informativeness and acquirer termination fees in a subsample of mergers with non-listed and listed targets

The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). Coefficients are estimated using OLS, 2SLS, and the endogenous switching model. Standard errors are robust to heteroskedasticity. Parentheses contain T-statistics in the case of OLS and z-statistics in the case of IV and the endogenous switching model. All variables are defined in Appendix Table A1.

	Dependent variable: Price informativeness			
	Non-listed targets		Listed targets	
A. OLS				
Term fee D	0.131 (1.6)	0.141 (1.7)	0.135 (2.82)	0.146 (3.06)
Control variables	Yes	Yes	Yes	Yes
Quadratic trend	Yes	No	Yes	No
Year fixed effects	2012-2018	Yes	2012-2018	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
R^2	0.272	0.273	0.293	0.305
Number of observations	6,772	6,772	3,897	3,897
B. IV				
Term fee D	0.916 (2.65)	0.676 (1.94)	0.650 (3.31)	0.742 (3.81)
Control variables	Yes	Yes	Yes	Yes
Quadratic trend	Yes	No	Yes	No
Year fixed effects	2012-2018	Yes	2012-2018	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
R^2	0.262	0.295	0.272	0.278
Number of observations	6,772	6,772	3,897	3,897
B. Endogenous Switching				
Term fee D	1.304 (3.34)	1.246 (3.24)	0.654 (3.16)	0.783 (4.35)
Control variables	Yes	Yes	Yes	Yes
Quadratic trend	Yes	No	Yes	No
Year fixed effects	2012-2018	Yes	2012-2018	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Number of observations	6,772	6,772	3,897	3,897

Table A1
Variable Definitions

Variable	Definition
A. Dependent variables	
Price informativeness	The natural logarithm of the ratio of variation in daily stock returns caused by firm specific information to the variation in stock returns caused by the market, the industry, the size factor and the book-to-market factor. Returns are measured over the period +2 through +22 relative to the event date.
Withdrawn	Dummy variable equal to one if SDC status is “Withdrawn” and equal to zero if SDC status is “Completed.”
B. Covariates	
Announcement AR	Abnormal return on the announcement date for the merger. The model for computing normal return is estimated over the period −294 through −43 with an minimum of 126 observations and using the Fama-French three-factor model. The AR is trimmed at the 1st and 99th percentile.
Breadth of Ownership	The number of bidder shareholders filing 13F forms prior to the event date divided by the total number of institutions filing 13F forms prior to the event date.
Cashonly	Equal to one if SDC variable “percent cash” equals 100% or SDC variable “Consideration structure” equals CASHO. Zero otherwise.
Deal Value	Deal value as reported by Refinitiv SDC Platinum.
Ind. fixed effects	Based on Fama-French 12 industry portfolios
Inst. Ownership	Aggregate bidder ownership by institutions filing 13F forms. Measured before but as close to the event date as possible.
Lagged price inf.	The natural logarithm of the ratio of variation in daily stock returns caused by firm specific information to the variation in stock returns caused by market and industry factors. Returns are measured over the period −84 through −43 relative to the event date.
Leverage	Total debt divided by the sum of total debt and Market Cap (defined below). Total debt is sum of Compustat items dltd and dlc.
Market Cap	Bidder market capitalization on day −42 relative to the event date.
Market to Book	The bidder Market Cap divided by the book value of equity. Book value is Compustat book value of stockholders equity, plus balance sheet deferred taxes and investment tax credits (if available), minus the book value of preferred stock. Depending on availability, we use the redemption, liquidation, or par value (in that order) to estimate the value of preferred stock.
Normal volume	Average traded bidder volume over the period −294 through −43 relative to the event date.
Paramount	Dummy variable equal to one for the period 1994 through 2018 and zero for the period 1986 through 1993. Instrument for bidder termination fee.
Past one-year CAR	Cumulative abnormal daily return over the period −294 through −43 relative to the event date. The model for computing normal return is estimated over the period −546 through −295 with an minimum of 126 observations and using the Fama-French three-factor model.

... continued on next page

Variable	Definition
Runup	Cumulative abnormal daily return over the period -42 through -2 relative to the event date. The model for computing normal return is estimated over the period -294 through -43 with a minimum of 126 observations and using the Fama-French three-factor model.
Same industry	Acquirer and target is in the same industry based on Fama-French 12 industries.
Target is Public	The target is listed on a stock exchange. Classified by SDC.
Termination Fee D	Dummy variable equal to one if the merger agreement includes a bidder termination fee and the Termination Fee Size (defined below) is larger than its 25%-quantile (of all nonzero Termination Fee Size observations) and zero otherwise.
Termination Fee Size	The size of the fee to be paid by the bidder to the target if the bidder terminates the transaction divided by Market Cap (see above). This ratio is then multiplied by the Termination Fee Dummy (defined above).
Total Assets	Bidder total assets (Compustat variable at) from the last fiscal year prior to the event date.
Unsolicited	Equal to one if SDC has classified the deal as resisted by management and zero otherwise.
Volatility	Annualized daily volatility. Daily volatility computed over trading days -294 through -43 relative to the event date.

Table A2
Price informativeness and acquirer termination fees using subsamples selected on
acquirer announcement day abnormal return

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The column named “Negative signal” contains all observations with acquirer Announcement AR below -0.01. The column named “Positive signal” contains all observations with acquirer Announcement AR above 0.01. Coefficients are estimated using OLS and standard errors are robust to heteroskedasticity. T-statistics in parentheses. All variables are defined in Appendix Table A1.

	Dependent variable: Price informativeness			
	Negative signal	Positive signal	Negative signal	Positive signal
A. Termination Fee Dummy				
Term fee D	0.121 (2.05)	0.040 (0.62)	0.134 (2.28)	0.049 (0.75)
Inst. Ownership	-0.232 (-3.30)	-0.191 (-2.68)	-0.249 (-3.54)	-0.195 (-2.72)
Breadth of Ownersh.	0.716 (2.43)	0.727 (1.91)	0.617 (2.12)	0.767 (2.03)
Ln Deal Value	0.026 (1.84)	0.024 (1.78)	0.026 (1.85)	0.028 (2.03)
Cashonly	0.026 (0.71)	0.086 (2.28)	0.036 (0.97)	0.095 (2.53)
Unsolicited	0.060 (0.78)	0.065 (0.70)	0.074 (0.96)	0.067 (0.72)
Target is Public	-0.043 (-1.21)	-0.040 (-1.10)	-0.040 (-1.12)	-0.031 (-0.87)
Ln Firm Value	-0.148 (-6.62)	-0.113 (-5.14)	-0.144 (-6.22)	-0.118 (-5.24)
Market to book	0.000 (-0.06)	-0.008 (-1.96)	-0.001 (-0.24)	-0.008 (-1.87)
Leverage	0.278 (3.14)	0.098 (1.06)	0.275 (3.10)	0.127 (1.36)
Past one-year CAR	-0.034 (-1.56)	-0.049 (-2.22)	-0.037 (-1.66)	-0.053 (-2.43)
Volatility	-0.136 (-1.74)	-0.060 (-0.72)	-0.127 (-1.46)	-0.056 (-0.62)
Lagged price inf.	0.181 (11.57)	0.166 (10.33)	0.169 (10.57)	0.162 (9.87)
Normal volume	-0.030 (-1.79)	-0.066 (-4.14)	-0.030 (-1.73)	-0.065 (-4.05)
Runup	-0.109 (-1.35)	-0.268 (-3.45)	-0.109 (-1.36)	-0.275 (-3.57)
Announce CAR	0.095 (0.19)	0.717 (1.70)	-0.001 (0.00)	0.465 (1.12)
Same Industry	-0.029 (-0.76)	-0.056 (-1.54)	-0.033 (-0.86)	-0.050 (-1.36)
Trend	0.034 (3.40)	0.053 (4.79)		
Trend squared	-0.002 (-5.97)	-0.003 (-7.28)		
constant	1.964 (11.49)	2.065 (12.01)	1.918 (9.58)	2.142 (9.74)
Year fixed effects	2012-2018	2012-2018	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
R-sq	0.264	0.254	0.273	0.267
Number of obs.	4,185	4,177	4,185	4,177
B. Termination Fee Size				
Termination Fee Size	5.296 (3.92)	1.606 (1.14)	5.524 (3.97)	1.455 (1.02)
Other Control var.	Yes	Yes	Yes	Yes
Year fixed effects	2012-2018	2012-2018	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
R^2	0.266	0.255	0.275	0.267
Number of obs.	4,185	4,177	4,185	4,177

Table A3
Price informativeness using the Paramount dummy and interaction terms as
instruments for acquirer termination fee using sub-samples selected on acquirer
announcement day abnormal return (<-1% and >-1% as cutoff values)

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The columns named “Negative signal” contain all observations with acquirer Announcement AR below -0.01. The columns named “Positive signal” contain all observations with acquirer Announcement AR above 0.01. The coefficients are estimated using 2SLS and standard errors are robust to heteroskedasticity. Parentheses in the columns named “First stage” contain t-values. Parentheses in the columns named “Probit” and “Second stage” contain z-values. The row labeled “Effective F-statistic” contains the F-statistic for the Montiel-Pflueger robust weak instrument test. The row “5% critical value” contains the 5% critical values for a relative bias (IV bias divided by worst case OLS bias) of 5%. The weak IV tests are performed using the Stata function weakivtest. All variables are defined in Appendix Table A1.

	Negative signal			Positive signal		
	Probit	1st stage	2nd stage	Probit	1st stage	2nd stage
Term fee D			0.507 (3.13)			0.005 (0.02)
$\Phi(\hat{\theta}_0 + x_i\hat{\theta} + z_i\hat{\theta}_z)$		1.062 (16.26)			0.986 (13.27)	
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
pseudo R^2/R^2	0.351	0.285	0.267	0.334	0.246	0.274
Effect. F-stat.		138.800			99.84	
5% critical value		30.280			30.54	
Observations	4,041	4,041	4,041	3,995	3,995	3,995

Table A4
Endogenous switching model using sub-samples selected on acquirer announcement
day abnormal return: Quadratic Trend Specification

The sample consists of 14,545 mergers announced between 1986 and 2018. When the sample is required to have non-missing covariates, the sample size is 12,519. The merger data is from Refinitiv SDC Platinum (formerly Thomson Reuters SDC Platinum). The columns named “Negative signal” contain all observations with acquirer Announcement AR below -0.02. The columns named “Positive signal” contain all observations with acquirer Announcement AR above 0.02. The estimated model is equations (4), (5), and (11). Parentheses contain z-values. Square brackets contain 95% confidence intervals. All variables are defined in Appendix Table A1.

Variable	Negative signal		Positive signal	
	Selection: Termination Fee D	Outcome: Price informativ	Selection: Termination Fee D	Outcome: Price informativ
A. Treatment effect model				
Term fee D		1.175 (5.12)		-0.045 (-0.13)
Param dummy	0.956 (2.93)		1.118 (2.35)	
Param × Deal size	0.179 (2.05)		0.207 (1.66)	
Param × Cashonly	-0.578 (-1.57)		-1.039 (-2.21)	
Param × Bidder size	-0.235 (-2.57)		-0.252 (-1.50)	
Param × Bidder leverage	0.962 (1.32)		0.846 (0.97)	
Param × Runup	-1.101 (-1.44)		-0.593 (-1.42)	
Other Controls	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes
Number of observations	2,854	2,854	2,854	2,854
B. Model error correlations				
ρ_0	-0.742 [-0.847, -0.583]		0.150 [-0.238, 0.497]	
ρ_1	-0.524 [-0.713, -0.263]		0.0560 [-0.320, 0.417]	
σ_0	0.989 [0.948, 1.031]		0.972 [0.943, 1.002]	
σ_1	1.100 [0.971, 1.246]		0.976 [0.862, 1.105]	
$\sigma_{\epsilon 0}$	-0.734 [-0.885, -0.583]		0.146 [-0.229, 0.521]	
$\sigma_{\epsilon 1}$	-0.577 [-0.875, -0.278]		0.0546 [-0.323, 0.433]	
Wald test: $\rho_0 = \rho_1 = 0$	$Pr(\chi^2_2 > \hat{\chi}^2_2 = 49.55) = 0.000$		$Pr(\chi^2_2 > \hat{\chi}^2_2 = 0.57) = 0.751$	