The Role of Media in Takeovers:
Theory and Evidence

Matthias M. M. Buehlmaier*

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Abstract

Using text-based media content, this paper develops and empirically confirms a theory that explains how the media predicts takeover outcomes. It shows that positive media content about the acquirer predicts takeover success. Relative to other predictors proposed in the literature, the media measure is the most important explanatory variable in terms of marginal effect, significance, and goodness of fit.

Keywords: Mergers and Acquisitions (M&A), Takeovers, Media, News, Text-Based Information

JEL Classifications: G34, C11, D82, C72

*The University of Hong Kong, Faculty of Business and Economics, Pokfulam Road, Hong Kong. Office: +852 2219 4177, Fax: +852 2548 1152, email: buehl@hku.hk, web: www.buehlmaier.net. A previous version of this paper was circulated under the title “Takeovers and the Media.” My greatest debt is to Klaus Ritzberger, Toni Whited, and Josef Zechner, who provided me with invaluable advice and comments. I would like to express my deeply felt gratitude to them as they have constantly and generously shared their knowledge with me. I would like to thank Filippo Balestriere, Jonathan Berk, Gerhard Binas, Nicolas Bollen, Antonio Cabrales, Jacques Crémer, Thomas Dangl, Stefano Demichelis, Andrea Eisfeldt, Alexander Eisl, Matthew Ellman, Zsuzsanna Fluck, Vito Gala, Alois Geyer, Hamed Ghoddui, Denis Gromb, Klaus Gugler, Christian Haeckle, Michael Halling, Allaudeen Hameed, Christopher Hemessy, Emir Hrnic, Philipp Illeditsch, Natalia Ivanova, Christian Julliard, Michael Kisser, Chen Lin, Mathieu Luypaert, Fabio Maccheroni, Kristian Miltersen, Alexander Muermann, David Musto, Timo Mylovanov, Stijn Van Nieuwerburgh, Terrance Odean, Gordon Phillips, Pegaret Pichler, Jean-Charles Rochet, Ehud Ronn, Johannes Ruf, Laura Starks, Jacob Sagi, Stephen Shore, Jamsheed Shorish, Ron Siegel, Baran Siyahhan, Paolo Sodini, Leopold Sögner, Fallaw Sowell, Helmut Strasser, Oren Sussman, Jeffrey Timmermans, Sheridan Titman, Yalun Tu, Laura Veldkamp, Anne Villamil, Alexander Wagner, Neng Wang, Ross Watts, Jörgen Weibull, Russ Wermers, Youchang Wu, Wei Xiong, Vilimir Yordanov, Alexander Zimper, Jeffrey Zwiebel, and the participants in my presentations at BI Norwegian School of Management, European Economic Review Talented Economists Clinic, Hong Kong University of Science and Technology, Texas A&M University, Universitat Pompeu Fabra, University of Hong Kong, University of Illinois at Chicago, Vienna University of Economics and Business (WU), and University of Warwick for valuable discussions and comments.
1 Introduction

As is well known, mergers and acquisitions (M&A) are a key part of finance. The top ten M&A deals alone from 2000 to 2010 have a total deal value of more than $850 billion. Although merger activity is far off its peak of 2007, global dollar volume in announced deals rose to $2.4 trillion in 2010.\footnote{See Institute of Mergers, Acquisitions and Alliances (2011) and de la Merced and Cane (2011).} A seventh merger wave might be in the making, where historians and economists have identified six prior merger waves starting from the 1890s.

A central concern in M&A dealmaking is takeover success in terms of deal completion. The key determinants of the likelihood of deal completion considered in the existing literature are usually deal characteristics and firm characteristics. Examples of deal characteristics include dummy variables indicating whether a bid is unsolicited and whether the merger consideration is cash or stock. Examples of important firm characteristics are the amount of cash and cash equivalents, and the book to market ratio.

The financial media has so far received little attention as a potential determinant of takeover success. Ohl et al. (1995) show that newspaper content during takeovers is directly influenced by two factors: first, by companies’ press releases and second, by media access to management. This happens during a period of public information scarcity, where the major source of new information for journalists is the acquirer and the target. Ahern and Sosyura (2011) find that media coverage is often increased by bidders who originate more news stories. They do this before the public announcement of the takeover to obtain a short-lived increase in bidders’ stock prices. Finally, there is a growing literature that investigates the effect of the media on firms’ fundamentals,
stock market reactions, and corporate governance, but not on takeovers.²

However, little comprehensive research has been undertaken in the past that considers the effect of media content on the likelihood of deal completion. This question is not only important in itself. It also begs the question of why rational target shareholders pay attention to the news, although they are fully aware that deal insiders can manipulate media content. Target shareholders are key players because takeover success is impossible without their approval. The media is a potentially efficient tool to influence shareholders' beliefs, in particular when the company is widely held.

Because this paper is the first to study how the media affects takeover outcomes, it considers this question from theoretical and empirical perspectives. Analyzing a theoretical model is necessary. First, it sheds light on endogeneity resulting from strategic interaction of agents during takeovers. For example, the way the financial media is manipulated affects target shareholders' actions, and vice versa. Because there is no prior literature that deals with this question, it is far from obvious what happens in equilibrium. Second, the model provides a solid economic intuition by extending the classical models of Bagnoli and Lipman (1988) and Milgrom and Roberts (1986). Furthermore, it provides guidance on causality. Third, it avoids data dredging. This aspect is particularly important when considering this novel question where it is not a priori clear how to quantify text-based information. Fourth, the model answers why target shareholders pay attention to the news even in a rational expectations world. This is surprising, given that shareholders know that the media can be manipulated, that there might be distorted reporting, and that they can be misled.

In the empirical analysis, this paper uses the naïve Bayes model to quantify text-

²See, for example, Tetlock et al. (2008), Fang and Peress (2009), Dyck et al. (2008), and Engelberg and Parsons (2011).
based information. Naïve Bayes fits this paper’s research question well. First, naïve Bayes is the oldest algorithm used to classify documents. Despite its age and simplicity, it often outperforms far more sophisticated models and continues to be among the most successful algorithms. It is well-established in diverse fields such as finance (Antweiler and Frank (2004)), accounting (Li (2010)), and statistical learning (Hastie et al. (2009)).

Second, naïve Bayes provides an elegant solution to the problem that words can mean different things in different contexts (Loughran and McDonald (2011)). For example, a word occurring in a press article on takeovers can have a different meaning than the same word occurring in an article dealing with the stock market. Unless one uses content-specific word lists, this problem can result in misclassification of words. The consequence is an unreliable measure of text-based information. Naïve Bayes solves this problem by automatically creating a word list with a content-specific probabilistic interpretation. From a training sample of press articles, naïve Bayes estimates the relationship between the article’s content and the frequency of each word. If there is a link between the article’s content and a certain word, naïve Bayes automatically captures this link in the form of a conditional probability distribution.

This paper provides results on two fronts. First, the theoretical part shows how the media mitigates the information asymmetry between the acquirer and target shareholders. The media endogenously provides information about future valuations of the merged firm. Shareholders thus pay attention to the news, and the information they obtain influences whether they approve the deal. In equilibrium, positive media content about the acquirer thus predicts takeover success. Second, the empirical part regresses takeover outcome on a novel media measure constructed from naïve Bayes, controlling for deal characteristics, firm characteristics, and merger waves. The media measure is highly significant, has a large marginal effect, and strongly increases goodness of fit.
These results cannot be explained by alternative hypotheses such as reverse causality and information leakage by deal insiders.

This paper starts with a literature review in Section 2. The following Section 3 introduces the notation and the theoretical model. Section 4 solves the model and shows its equilibrium properties. Section 5 derives the empirical prediction and discusses its implications for the empirical methodology. Section 6 introduces the data and shows summary statistics. Section 7 shows the empirical methodology. It details how naïve Bayes is used to construct the text-based media measure and introduces the binary outcome model. Section 8 shows estimation results and Section 9 considers alternative hypotheses and robustness checks. Section 10 concludes and the Appendix contains the proofs for Section 4.

2 Background and Related Literature

On the theory side, this paper combines ideas from two strands of the literature. The key link between both strands is Ohl et al. (1995), who show in a takeover context that companies can run costly media campaigns.

The first strand is the classical takeover literature. Grossman and Hart (1980) consider a basic takeover bid mechanism and show that under their assumptions the argument behind the market for corporate control is flawed. The market for corporate control suggests that if current management is not acting in shareholders’ interest, an acquirer can make a takeover bid. It buys the company at a low price, manages it well, and sells it back at a higher price. If each shareholder is so small that his decision does not effect the takeover’s outcome, no shareholder has incentives to tender: if he tenders, he cannot participate in the share price appreciation resulting from improved
management after a takeover. Target shareholders thus have incentives to free-ride by not tendering their shares. Since nobody tenders, the takeover fails. The market for corporate control thus does not work.

Grossman and Hart (1980) propose exclusionary devices as a solution. An exclusionary device permits the acquirer to exclude minority shareholders from profiting from the increase in firm value brought about by the acquirer. An example is to modify the corporate charter to allow the acquirer to cheaply sell the firm’s assets to another company owned by the acquirer.

A key assumption underlying Grossman and Hart (1980) is that target shareholders are atomistic. This assumption means that there are many small shareholders and that none of them can affect the outcome of a bid. It is analogous to making price-taking assumptions. Bagnoli and Lipman (1988) formalize Grossman and Hart (1980) by analyzing models with finitely and infinitely many target shareholders. They show that exclusion is not necessary because some shareholders are pivotal. A shareholder is pivotal if he can prevent takeover success by refusing to tender his shares. Pivotal shareholders arise endogenously as a consequence of the equilibrium. The intuition is straightforward. In equilibrium, a pivotal shareholder is supposed to tender. If he tenders, the takeover succeeds and the acquirer pays the bid price to him. If he instead deviates and does not tender, the takeover fails: the acquirer obtains an insufficient amount of shares and thus fails to gain control of the target. Because of the takeover’s failure, the pivotal shareholder obtains the current share price, which is less than the bid price. He thus has no incentives to deviate and therefore tenders. The market for corporate control works in Bagnoli and Lipman (1988) without exclusion because of pivotal shareholders.

The second strand is the classical literature on advertising. Formalizing ideas from
Nelson (1974), Milgrom and Roberts (1986) address the following puzzle: why do consumers pay attention to advertising that has little or no obvious informational content? An example is the advertising campaign for the 1984 Ford Ranger truck. The commercial shows trucks being thrown out of airplanes, followed by skydivers. Milgrom and Roberts (1986) reason as follows. In equilibrium, high-quality brands advertise more than low-quality brands. Low-quality brands have no incentives to mimic: they know ex ante that ex post their profits are so low that paying for advertising does not pay off. Since high-quality brands advertise more, and since advertising expenditures are indirectly observable through commercials, consumers respond positively to advertising. The message to consumers is simply: “we are spending an astronomical amount of money on this ad campaign.”

On the empirical side, the following papers are related. Similar in spirit to Ohl et al. (1995), Ahern and Sosyura (2011) find evidence that firms manage media coverage during takeovers. They show that bidders in stock mergers originate more news stories before the announcement date. This media activity results in a short-lived run-up in the bidder’s stock price. The key differences to this paper are as follows. First, Ahern and Sosyura focus on the time period before the public takeover announcement, while this paper considers the subsequent time period. Second, Ahern and Sosyura show that press releases generated during merger negotiations increase firms’ visibility, while this paper shows that the media discloses important fundamental information about the acquirer. Third, Ahern and Sosyura consider media coverage by focusing on the number of news articles. This paper analyzes media content by considering text-based information.

Antweiler and Frank (2004) are among the first to address the interpretation of unstructured text in a financial context. They study the effect of messages posted on
Yahoo! Finance and Raging Bull on two stock market indices. As this paper, Antweiler and Frank use naïve Bayes to quantify text-based information. Confirming Harris and Raviv (1993), they find that disagreement among posted messages is associated with increased trading volume. Although stock messages have a statistically significant effect on stock returns, their economic significance is small.

Tetlock (2007) studies the effect of a popular Wall Street Journal column on the stock market. He uses an automated program, the General Inquirer, to analyze the column. The General Inquirer counts words that fall within 77 categories from the Harvard psychosocial dictionary. Using principal component analysis, Tetlock identifies the most relevant categories and derives a pessimism factor. He shows that the pessimism factor predicts downward pressure on stock prices followed by a reversion and that high or low pessimism predicts high trading volume. This finding is consistent with theoretical results on noise and liquidity traders.

The key differences between Antweiler and Frank (2004) and Tetlock (2007) on the one hand and this paper on the other hand are as follows. First, this paper shows that it is necessary in a takeover context to add an additional layer of dimensionality to the empirical media measure. That is, it is necessary to quantify text-based information about the acquirer instead of considering general positivity/negativity of reporting. Second, the conceptual focus of this paper is on corporate finance, while Antweiler and Frank (2004) and Tetlock (2007) consider the effect of message boards and the media on asset prices.

Veldkamp (2006) relates surges in prices and cross-market price dispersion to media coverage. Veldkamp explains these anomalies with an information market complementarity. Her result obtains because information is fundamentally distinct from other goods. It has a fixed cost of discovery and a near-zero cost of replication. High volume
thus makes information inexpensive and low prices induce investors to buy information that others also buy. Veldkamp finds empirical support for the model’s prediction that asset market movements generate news and that news raise prices and price dispersion. The key conceptual difference between Veldkamp (2006) and this paper is that Veldkamp (2006) argues with an information market complementarity while this paper tests a signaling model.

3 The Model

The following game extends the classical Bagnoli and Lipman (1988) model by adding asymmetric information and a signaling stage in the spirit of Milgrom and Roberts (1986). Figure 1 illustrates the game’s timeline. There are two companies, the acquirer and the target. The acquirer is either of high $H$ or of low $L$ type. The high type increases the value of the target after a takeover while the low type destroys value. A takeover thus causes the value of a share of target stock to change to $p_t$ from $p$, where $t \in \{H, L\}$ and $p_L < p < p_H$. This assumption is motivated by standard arguments pertaining to potential benefits and costs of takeovers. Examples include agency costs, managerial ability, efficiency, operating and financial synergy, taxes, and market power.

[Figure 1 about here.]

The $n$ target shareholders do not know the acquirer’s type. They share a common prior\(^3\)

$$\beta := P(T = H) \in (0, 1),$$

(1)

\(^3\)See Aumann (1976), Yildiz (2003), and Hanson (2006).
where $T$ denotes a random variable with realizations $t \in \{H, L\}$ representing target shareholders’ uncertainty about the acquirer’s type.

At the initial stage the acquirer decides on the bid price $b \geq 0$ of its any-and-all bid. This model applies to cash tender offers and exchange offers. In the case of an exchange offer, $b$ corresponds to the value of the securities offered as consideration.

After making the bid, the acquirer obtains previously unknown information about the target through interaction with target shareholders or target management. The acquirer learns how a potential merger would affect the target’s value. The acquirer thus privately learns its type $t$.

The assumption that there is an information asymmetry between the acquirer and target shareholders follows from two considerations. First, deal insiders by their nature are well-informed. There are many deal insiders such as acquirer management and board, target management and board, sell-side advisors, and buy-side advisors. Empirical evidence suggests that the information asymmetry between the acquirer and target shareholders is particularly severe. For example, when regressing takeover outcome on firm characteristics, only the acquirer firm characteristics are significant while target firm characteristics are insignificant (Table 3). Furthermore, Ahern and Sosyura (2011) find that the acquirer manages the media, which is consistent with this assumption. Second, target shareholders, who have been holding target stock for some time, already know their company relatively well. (Day traders are an exception and are not the focus of this paper.) On the other hand, it takes time and effort to analyze the acquirer and become familiar with it because the acquirer was unknown to target shareholders before the announcement. Even in the unlikely case that all information about the acquirer is readily available, it is still not straightforward to interpret this information in the context of a takeover because it pertains to the merged company. This argument only
relies on economic frictions such as time costs and effort that result from data collection, valuation, and interpretation, all of which take time and experience. Behavioral explanations such as limited attention exacerbate these frictions, but are not necessary to motivate this assumption.

The simplifying assumption that the acquirer does not know its type before making the bid is highly stylized. The key reason for making this assumption is that it avoids introducing complexity that distracts from the main focus of this paper. It sharpens in particular the conceptual focus on the media as a potential signal of private information. This simplifying assumption is not essential for this paper’s results. Milgrom and Roberts (1986)’s model shows that this paper’s implications for the media and takeover outcomes stay unchanged if the acquirer may signal his type through the bid $b$. The reason for this result is that in equilibrium, the acquirer signals both through the bid price and through the media campaign.

Knowing its type, the acquirer decides whether to run a media campaign. A media campaign consists of collecting and actively spinning new information that is routinely generated throughout the takeover process. After spinning the news, the acquirer releases information to the media. The media then passes this spun information on to target shareholders. This assumption on the media is directly motivated by the results in Ohl et al. (1995), who show the following in a takeover context. First, newspaper articles’ content is directly influenced by companies’ press releases and by media access to acquirer management. Second, acquirer and target management are the only source of new information for journalists during a takeover. It is thus naïve to assume that journalists simply report accurately. Ohl et al. (1995) show that journalists simply reprint most of the information fed to them during a takeover. Ahern and Sosyura (2011) also confirm this result.
While a media campaign could potentially be initiated by agents other than the acquirer, the impact of the acquirer’s campaign is of first order. It is of first order because of the informational asymmetry between target shareholders and the acquirer. Potential channels of the media campaign include newspaper articles, the acquirer CEO giving interviews on television, or the acquirer running advertisements in the financial press. This paper’s empirical part focuses on the first channel, although the game-theoretic model remains valid for the other channels as well.

Knowing its type, the acquirer decides on its potentially degenerate mixed strategy

$$\xi_t := P(M = 1|T = t) \in [0, 1], \quad t \in \{H, L\}, \quad (2)$$

where the event \(\{M = 1\}\) denotes the occurrence of a media campaign and \(\{M = 0\}\) denotes its absence. The acquirer endogenously chooses a random variable \(M\) with realizations in \(\{0, 1\}\). Only the distribution of \(M\) matters in this game. One can thus W.L.O.G. think of \(\xi_t\) as a choice variable.

A media campaign is costly. The acquirer hires “spin doctors” in the form of a public relations (PR) firm or the acquirer has its own PR department. The acquirer thus incurs costs \(c > 0\) if the event \(\{M = 1\}\) occurs, that is, if the realization \(m\) of the endogenous random variable \(M\) is equal to one.

This paper assumes that the cost of spinning the news is the same for both the high and the low type. An alternative model would be based on the observation that spinning the news is more costly for the low type compared to the high type. That is, the type-\(t\) acquirer pays \(c_t\), where \(c_H < c_L\). This model specification places weaker restrictions on the potential existence of a separating equilibrium in which the high type runs a media campaign and the low type abstains from running a campaign. The
approach taken in this paper is thus conservative with regard to the assumptions on
the media campaign’s cost.

Target shareholders cannot observe the realization $m$, that is, they do not know
whether or not the acquirer engaged in a media campaign. Reading between the lines,
they instead obtain a noisy signal $s \in \{0, 1\}$. The signal $s$ is a realization of the
random variable $S$, where $S$ is positively correlated with the media campaign. The
signal precision

$$\delta := P(S = 1 \mid M = 1) = P(S = 0 \mid M = 0) > \frac{1}{2} \quad (3)$$

determines the conditional dependence of $S$ on $M$. Shareholders incorporate the new
information contained in the signal by updating their belief to the posterior

$$\beta^s := P(T = H \mid S = s), \quad s \in \{0, 1\}. \quad (4)$$

The purpose of the noise in the signal is to make the model more realistic: tar-
get shareholders cannot directly observe whether the acquirer runs a media campaign.
There is always the chance that target shareholders misinterpret what they read in the
press. That is, it is possible that target shareholders believe that media content was
spun by a campaign while in fact it was not (and vice versa). An alternative model for-
mulation in which target shareholders can observe $m$ directly without noise essentially
yields the same results.

The primary reason for shareholder uncertainty about the acquirer’s type is uncer-
tainty about the acquirer’s actions implied by $\xi_H$ and $\xi_L$. Although the noisy signal
makes this model more realistic, its implications for shareholder uncertainty are of sec-
ond order: even $\delta = 1$ does not resolve uncertainty if at least one acquirer type plays a
non-degenerate mixed strategy.

At the end of the game, shareholder approval of the takeover takes place in the form of a vote or through shareholders’ tendering decision. This paper focuses on the more challenging case of a tender offer. This case is more challenging because of potential free-rider problems. Shareholder voting trivially obtains by replacing the tendering decision with an arbitrary voting system. The media dynamics and the empirical prediction stay the same.

The acquirer needs at least \( k \) shares to gain control of the target. Each shareholder holds one share and decides whether or not to tender. If shareholders tender at least \( k \) shares, the takeover succeeds. Otherwise it fails. If a shareholder does not tender and the takeover succeeds, his expected payoff is \( p^s - p \), where

\[
p^s := \beta^s p_H + (1 - \beta^s) p_L
\]  

(5)

is shareholders’ expected post-takeover value per target share. If a shareholder tenders and the takeover succeeds, his payoff is \( b - p \). If the takeover fails, each shareholder’s payoff is zero.

Acquirer management obtains nonmonetary private benefits of control \( z \) from running the target, where

\[
k(p - p_L) < z.
\]  

(6)

The lower bound on \( z \) ensures that the low type has incentives to bid for the target although it reduces target value. Acquirer management’s final payoff is

\[
- c 1_{m=1} + \left[ z + (p_t - b) \sum_{i=1}^{n} \sigma_i \right] 1_{\sum_{i=1}^{n} \sigma_i \geq k}.
\]  

(7)
where $\sigma_i \in \{0, 1\}$ is target shareholder $i$’s pure tendering strategy and $\mathbbm{1}$ is the indicator function. Target shareholder $i$ tenders if and only if $\sigma_i = 1$.

This paper focuses on pure tendering strategies because pure strategies avoid the ambiguities associated with mixed strategies. In contrast, the acquirer’s media strategy is a mixed strategy. If this signaling game yields a separating or pooling equilibrium, then allowing for mixed strategies of the acquirer makes this paper’s result stronger: although the acquirer can play a mixed strategy, it ends up playing a pure strategy (i.e. a degenerate mixed strategy).

### 4 Equilibrium

The following lemma shows how target shareholders incorporate the new information obtained from the noisy signal $s$ into their posterior belief $\beta^*$.  

**Lemma 1 (Posterior Beliefs).** Target shareholders’ posterior beliefs are

$$
\begin{align*}
\beta^0 &= \beta \cdot \frac{(1 - \delta)\xi_H + \delta(1 - \xi_H)}{1 - \zeta}, \\
\beta^1 &= \beta \cdot \frac{\delta\xi_H + (1 - \delta)(1 - \xi_H)}{\zeta},
\end{align*}
$$

where $\zeta = P(S = 1) = \delta\mu + (1 - \delta)(1 - \mu)$ and $\mu = P(M = 1) = \xi_H\beta + \xi_L(1 - \beta)$.

Figure 2 shows the posterior $\beta^1$ as a function of $(\xi_H, \xi_L)$. This posterior obtains after a media signal indicating the occurrence of a media campaign, that is, after shareholders observing the event $\{S = 1\}$. The economic intuition is straightforward and results from the correlation of the signal with the acquirer’s media campaign. If the high type is more likely to run a campaign, then target shareholders are more likely to believe to be facing a high type when they observe $\{S = 1\}$. The posterior belief $\beta^1$ is thus an
increasing function of $\xi_H$. A similar argument shows in complete analogy why $\beta^1$ is a decreasing function of $\xi_L$.

[Figure 2 about here.]

Consider target shareholders’ decision to tender. Distinguish between the following four cases, where $a \lor b := \max\{a, b\}$ and $a \land b := \min\{a, b\}$. First, suppose that $p \lor p^s < b$. All shareholders have incentives to tender, thus $\sigma_i = 1$ for all $i \in \{1, \ldots, n\}$. The takeover succeeds and the acquirer obtains $-c \mathbb{1}_{m=1} + z + n(p_t - b)$. Second, suppose that $b < p \land p^s$. No shareholder has incentives to tender, thus $\sigma_i = 0$ for all $i \in \{1, \ldots, n\}$. The takeover fails and the acquirer obtains $-c \mathbb{1}_{m=1}$.

Third, suppose that $p < b < p^s$. Focus on pure tendering strategies. Then any set of shareholder strategies in which exactly $k$ shares are tendered is an equilibrium. For example, $\sigma_1 = \ldots = \sigma_k = 1$ and $\sigma_{k+1} = \ldots = \sigma_n = 0$ is an equilibrium. Those shareholders who do tender have no incentive to deviate: if they would not tender, the takeover would fail and they would receive $p$ instead of $b$. Those shareholders who do not tender also have no incentive to deviate: if they would tender, the takeover would still succeed and they would receive $b$ instead of $p^s$. As a result, exactly $k$ shares are tendered, the takeover succeeds, and the acquirer obtains $-c \mathbb{1}_{m=1} + z + k(p_t - b)$.

Fourth, suppose that $p^s < b < p$. In equilibrium no shareholder tenders ($\sigma_i = 0$ for all $i \in \{1, \ldots, n\}$). No shareholder has incentives to deviate: if a shareholder would tender, the takeover would still fail and his utility would stay unchanged. The takeover thus fails and the acquirer obtains $-c \mathbb{1}_{m=1}$.

Another equilibrium is that every shareholder tenders ($\sigma_i = 1$ for all $i \in \{1, \ldots, n\}$). No shareholder has incentives to deviate: if a shareholder would not tender, the takeover would still succeed and the shareholder would obtain $p^s$ instead of $b$. This equilibrium
is in the spirit of the bank run equilibrium of Diamond and Dybvig (1983). It gives the acquirer perverse incentives to convince shareholders that it is unfit to run the target company. This equilibrium is implausible because it would lead to regulatory intervention or to counterbids from other potential acquirers. It is also implausible because it would fail if shares are distributed unevenly so that large shareholders become pivotal. I thus do not focus on this equilibrium in the remainder of this paper.

Target shareholders’ tendering strategies in case of shareholder indifference need to ensure that the acquirer’s maximization problem with respect to $b$, $\xi_H$, and $\xi_L$ is well-behaved. Target shareholders thus tender $k$ shares if $b = p \leq p^*$ or if $b = p^* > p$. Otherwise no equilibrium exists. Because the acquirer’s utility is a decreasing function of the bid price for $b \geq p$, the acquirer bids $b^* = p$ in equilibrium (see Lemma 2 in the Appendix). This result applied to (7) shows that the acquirer obtains at most the amount $z + k(p_H - p)$ from a successful takeover because target shareholders tender at most $k$ shares. To make the model interesting, the cost of the media campaign must be lower than the maximal amount gained in the takeover. Otherwise an empty set of nontrivial equilibria obtains because no acquirer type has incentives to run a media campaign. Therefore, suppose that

$$c < [z + k(p_H - p)](2\delta - 1) =: \bar{c}.$$  \hspace{1cm} (9)

holds for the remainder of this paper.
Define
\[
\bar{\beta} := \frac{(p - p_L)(1 - \delta)}{(p - p_L)(1 - \delta) + (p_H - p)\delta},
\]
\[
\bar{\beta} := \frac{(p - p_L)\delta}{(p - p_L)\delta + (p_H - p)(1 - \delta)},
\]
\[
c := [z - k(p - p_L)](2\delta - 1).
\]

It holds that \(0 < \beta < \bar{\beta} < 1\) and that \(\bar{c} < \bar{c}\) (see Lemma 3 in the Appendix). This observation shows how \(\beta\) and \(\bar{\beta}\) partition the unit interval into the three subintervals \([0, \beta]\), \([\beta, \bar{\beta}]\), and \([\bar{\beta}, 1]\). The economic intuition pertains to shareholders’ prior belief about the acquirer. If \(\beta \in [0, \beta]\), shareholders are relatively pessimistic about the acquirer because they are relatively certain that they face a low type. If \(\beta \in [\beta, \bar{\beta}]\), shareholder uncertainty about the acquirer’s type is relatively large. Neither do they believe that they face a high nor a low type with relatively high certainty. Finally, if \(\beta \in [\bar{\beta}, 1]\), shareholders are relatively certain to be facing a high type.

**Theorem** (Perfect Bayesian Equilibrium).

- If \(\beta \in [\beta, \bar{\beta}]\) and \(c \geq c\), then \((\xi_H^*, \xi_L^*) = (1, 0)\). The takeover succeeds after \(s = 1\) and fails after \(s = 0\).

- If \(\beta \notin [\beta, \bar{\beta}]\) or \(c < c\), then \((\xi_H^*, \xi_L^*) = (0, 0)\). The takeover succeeds if \(\beta \in [\bar{\beta}, 1]\) and it fails otherwise.

The first bullet point contains the key result of this paper. It shows that target shareholders pay attention to the news, despite the risk of distorted reporting. Shareholders pay attention to the news for two reasons. First, they know that only the high type runs a media campaign. The media is thus informative: observing a signal
indicating the occurrence or absence of a media campaign allows shareholders to make inferences about the acquirer’s type. Second, \( n - k \) target shareholders do not tender. That is, a potentially large fraction of shareholders keep their shares. These shareholders are interested in the future value of the merged firm and thus in the acquirer’s type.

The economic intuition behind the theorem’s first bullet point is as follows. Shareholder uncertainty about the acquirer is large (\( \beta \in [\underline{\beta}, \bar{\beta}] \)). The costs of running a media campaign are intermediate (\( c \in [\underline{c}, \bar{c}] \)). The high type knows that it is going to profit from the post-takeover increase in target value even if it pays for the media campaign. The high type has thus incentives to distinguish itself from the low type by running a media campaign. The low type has no incentives to mimic the high type because a media campaign is too costly. It is too costly because the low type’s private benefits of control do not suffice to compensate for both the decrease in target value and the costs of the media campaign. Since the media signal is positively correlated with the media campaign, shareholders believe that a takeover creates value only if they observe a positive media signal \( s = 1 \). Since shareholder beliefs determine the takeover’s outcome, a positive media signal entails takeover success and a negative signal entails failure.

The theorem’s second bullet point shows under which conditions the media is unimportant for target shareholders because the acquirer pools. This case obtains if running a media campaign is too cheap or if target shareholders are relatively certain that they are facing the high or the low type.
5 Implications for the Empirical Methodology

The media plays only a role in the separating equilibrium: only in this equilibrium does the media signal carry information that is useful to target shareholders. The two conditions that have to hold for the existence of this equilibrium are \( \beta \in [\bar{\beta}, \bar{\beta}) \) and \( c \geq \bar{c} \). The first condition \( \beta \in [\bar{\beta}, \bar{\beta}) \) means that target shareholders are relatively uncertain about the acquirer’s type. This condition poses only a very weak restriction because it is likely to hold empirically in the majority of takeover cases.

The second condition is \( [z - k(p - p_L)](2\delta - 1) \leq c \). Since (6) holds and since \( \delta \in (1/2, 1] \), a sufficient condition is \( z \leq c \). That is, if private benefits of control are less than the cost of the media campaign, the theorem’s second condition \( c \geq \bar{c} \) holds.

There is anecdotal evidence that the costs of media campaigns can be substantial and that spending money on these campaigns has a long tradition in takeovers. For example, San Diego Gas & Electric and Southern California Edison have spent at least around $4 million on merger-related public relations and advertising expenses in 1989.\(^4\) More recently, activist shareholder Bill Ackman, who often acts as a financial buyer in takeovers, ran a $10 million campaign in 2009.\(^5\) Furthermore, the average duration of a takeover is 129 days (Table 1), which further confirms that expenditures for PR firms during a takeover can be relatively large.

This paper’s empirical prediction relates the media signal \( s \) to the takeover’s outcome. The theorem shows that under empirically plausible assumptions, the takeover succeeds after \( s = 1 \) and fails after \( s = 0 \). In equilibrium, the signal’s informational content matters. It matters because it endogenously fixes target shareholder’s posterior belief about the acquirer. This is so because off-equilibrium the signal \( s \) carries no

\(^4\)See Johnson (1989). This number is inflation adjusted.
information about the acquirer: the strategies ($\xi_H, \xi_L$) and thus posterior beliefs do not have any meaning to target shareholders off-equilibrium.

In equilibrium, the signal $s = 1$ thus yields positive information about the acquirer (i.e. a large $\beta^1$) and the signal $s = 0$ yields negative information about the acquirer (i.e. a small $\beta^0$). This consideration immediately implies the following:

**Empirical Prediction.** *Positive media content about the acquirer predicts takeover success.*

The empirical prediction shows that quantifying positivity or negativity of media reporting is not enough. It shows the need to add an additional layer of dimensionality to the empirical media measure. This layer is information *about the acquirer*. Constructing a media measure that quantifies text-based information along this dimension has two key advantages. First, it allows a direct test of the empirical prediction. It eliminates in particular the need for further auxiliary hypotheses and test implications. Second, such a media measure makes reverse causality as a potential alternative explanation less likely. *Reverse causality* means in this context that the media measure predicts takeover outcomes because the media writes about the prospects of takeover success. Even if the media speculates about the takeover’s outcome, the media measure ignores this type of information because it quantifies information along a different dimension. That is, the media measure captures information about the acquirer and not information about the takeover’s expected outcome. These are disjoint information sets. Although manual inspection of a randomly chosen subsample of press articles shows that the media only rarely speculates on the deal’s outcome, the construction of the media measure provides an additional safeguard against reverse causality driving the results. Section 9 considers reverse causality from an additional perspective.
The empirical analysis is valid for cash deals and stock deals because the model in Section 4 allows the merger consideration to be cash (i.e. a tender offer) or stock (i.e. an exchange offer). Even in a tender offer there are endogenously some free-riding target shareholders who do not tender and instead hold on to their shares. These shares later get converted into shares of the merged firm. Thus even in a tender offer there are endogenously some target shareholders who care about future valuations of the merged company.

Target shareholders are key players because legally a takeover cannot succeed without their approval in the form of a vote or tendering decision. A deal, however, still can fail for other reasons. Examples include material adverse change, a competing bidder wins, acquirer shareholders vote against the merger, or regulatory intervention. Material adverse change, however, often results in deal failure because of the anticipation that it is impossible to convince target shareholders to approve the deal. This paper does not focus on challenged deals because media dynamics can be very different in bidding wars. Acquirer shareholders can only vote in a very limited number of cases on the deal, and even in those cases they often approve the deal. For example, if the amount of shares issued is less than 20% of pre-deal levels, acquirer shareholders are not even entitled to vote. If the merger consideration consists entirely of cash or debt, acquirer shareholders also do not get to vote. Finally, regulatory intervention causes deals to fail only relatively infrequently.

6 Data and Summary Statistics

Takeover data are from the SDC Platinum Mergers & Acquisitions database pertaining to US targets. The criterion for sample inclusion is as follows. Only takeover attempts
with announcement dates between January 1, 2000 and December 31, 2006 are included. This choice of time period is motivated by two considerations. First, the time period covers approximately one business cycle and one merger wave from its peak in 2000 to its peak in 2007. Second, it avoids sample selection bias due to right censoring. The end date of the sample is determined by the announcement date, not by the date withdrawn or the closing date. This means that the outcomes of all takeover attempts in the sample are known to the econometrician because the end date of December 31, 2006 is far enough in the past. This implies in particular that the sample does not exclude takeovers with yet unknown outcome, which could lead to bias because exclusion might be nonrandom. The alternative sample inclusion criterion would be to use all mergers with available information that close by a certain date. This alternative criterion could lead to sample selection bias because in later years it excludes in a nonrandom way those takeovers that have been announced but have not yet closed.

The sample excludes the industries “energy and power,” “financials,” and “government and agencies.” Only takeover attempts with enterprise value at announcement of at least $500 million are included. The motivation for this criterion is that media coverage mainly pertains to large deals. By a similar argument, the sample only includes publicly traded acquirers and targets. A second reason for this inclusion criterion is that the media is of particular importance for widely-held firms. Cross-border deals are excluded: government policy, regulation, tariffs, quota, exchange rates, and political and economic stability are confounding factors that are nontrivial to control for when focusing on the media. Challenged deals are excluded because media dynamics fundamentally differs in bidding wars. Finally, only M&A transactions for majority/remaining interest and tender offers are included. The sample consists of 348 takeover attempts. 320 takeovers are successful (the variable status has value completed) and 28 takeover
attempts fail (status is withdrawn).

To capture the effect of merger waves and macroeconomic factors, this paper considers the variable prevTakeovers. This variable consists for each takeover attempt of the number of successful takeovers in the previous 100 days.

Deal and firm characteristics are from SDC. They encompass the usual variables in the standard literature on mergers and acquisitions. Deal characteristics include the number of days between announcement date and effective date or date withdrawn, a stock swap dummy, a dummy indicating the presence of anti-takeover devices, a tender offer dummy, a dummy indicating whether or not negotiations preceded an offer (unsolicited dummy), a proxy fight dummy, deal value, deal value to EBITDA, deal value to net sales, toehold, runup, markup, and premium (runup + markup). Firm characteristics include price to earnings, earnings per share, EBITDA to total assets, working capital to total assets, net income to net sales, price to sales, cash, cash to total assets, common equity, market value of equity, book to market, leverage, size, and share price return between announcement date and the date four weeks prior to announcement.

News articles are from Dow Jones Factiva. For each takeover attempt, I include those articles that contain the names of the acquirer and the target within the first one hundred words. I collect articles that appear between the announcement date and one day prior to the effective date or the date withdrawn. Omitting the effective date or the date withdrawn ensures that any variable derived from news articles is exogenous with respect to the takeover outcome. Section 9 also considers omitting more days prior to the takeover attempt’s outcome. A text document collection is the set of all included news articles. The resulting text document collection contains 82,830 news articles. Tables 1 and 2 show summary statistics and definitions of the most important
variables, that is, variables that survive the general-to-specific model selection procedure in Section 8.

[Table 1 about here.]

[Table 2 about here.]

7 Methodology

7.1 Constructing the Media Variable

This section shows how this paper quantifies text-based information. The software implementation uses the R packages described in Feinerer et al. (2008) and Hornik et al. (2009). The first step consists of preprocessing the text document collection. Preprocessing entails conversion to lowercase, removal of stop words (examples include as and the), and stemming. Stemming is the process of erasing word suffixes to retrieve their radicals. It reduces complexity without significant loss of information.

The second step consist of creating a so-called term-document matrix from the preprocessed text document collection. This process is best illustrated by an example. Consider the text document collection consisting of the following two news articles (each article consists of one sentence for clarity of exposition and only lowercase conversion has been performed):

1. media content predicts takeover outcomes.

2. the media is the missing link.

Counting the occurrence of each word (term) in each text document yields the term-document matrix
Rows pertain to news articles and columns pertain to terms. The matrix element $f_{i,j}$ in row $i$ and column $j$ shows the frequency of term $j$ in news article $i$.

With 116,901 columns, the resulting term-document matrix is very large. Many nonsensical terms such as *aacplus* or *zzilr* are included. These terms are artifacts and are included because they occur at least once in at least one text document. Removing sparse terms eliminates these artifacts. It reduces the matrix dramatically without losing significant relations inherent in the matrix. Removing columns that have at least a 99 percentage of terms occurring zero times in a document yields a term-document matrix with 2,012 columns.

The third step consists of estimating a model that relates the news articles represented by the term-document matrix and their content. This paper uses the standard *naïve Bayes* model. The motivation for using this model is based on three of its properties. First, naïve Bayes works very well when tested on actual data sets (Hastie et al. (2009)). Second, it is computationally simple. This property is important because of the large dimensional nature of text-based information. Third, out-of-sample prediction of the variable of interest works very well (Antweiler and Frank (2004)).

Let $C_i$ denote a random variable that has value one if news article $i$ contains positive information about the acquirer and value zero otherwise. Let $F_{i,j}$ denote random variables corresponding to the realizations $f_{i,j}$, $j = 1, \ldots, 2012$. That is, $F_{i,j}$ pertains
to the frequency of term $j$ in the news article $i$. Then Bayes’ rule implies

$$P(C_i = c | F_{i,1} = x_1, \ldots, F_{i,2012} = x_{2012})$$

$$\propto P(C_i = c) P(F_{i,1} = x_1, \ldots, F_{i,2012} = x_{2012} | C_i = c)$$

$$= P(C_i = c) \prod_{l=1}^{2012} P(F_{i,l} = x_l | C_i = c, F_{i,1} = x_1, \ldots, F_{i,l-1} = x_{l-1})$$  \hspace{1cm} (11)$$

for all $c \in \{0,1\}$ and all $x_1, \ldots, x_{2012} \in \mathbb{N}_0$, where $\mathbb{N}_0$ is the support of $F_{i,l}$.

The key assumption of naïve Bayes is that the $F_{i,j}$’s are conditionally independent given $C_i$. Formally, $P(F_{i,l} = x_l | C_i = c, F_{i,1} = x_1, \ldots, F_{i,l-1} = x_{l-1}) = P(F_{i,l} = x_l | C_i = c)$. This assumption motivates the use of the term “naïve” in the naming of this model. Despite making this simplifying assumption, naïve Bayes often performs better with actual data sets than more sophisticated models. Figure 3 shows a path diagram illustrating the conditional dependencies implied by naïve Bayes.

[Figure 3 about here.]

Applying conditional independence to (11), we obtain the following naïve Bayes model, which is straightforward to estimate with maximum likelihood:

$$P(C_i = c | F_{i,1} = x_1, \ldots, F_{i,2012} = x_{2012}) \propto P(C_i = c) \prod_{l=1}^{2012} P(F_{i,l} = x_l | C_i = c)$$

$$= P(C_i = c) \left( \sum_{l=1}^{2012} x_l \right)! \prod_{l=1}^{2012} P(\text{obtain term } l | C_i = c)^{x_l}. \hspace{1cm} (12)$$

The last equality follows because the term-document matrix implies a multinomial distribution. The probability $P(\text{obtain term } l | C_i = c)$ is the probability of obtaining term $l$ when sampling from documents in category $c$.

Estimating the naïve Bayes model (12) with maximum likelihood requires observable
realizations of $C_i$. To generate these realizations, draw a random sample of size 400, discard those articles that do not directly pertain to the takeover in consideration (e.g. general market commentaries), and classify the remaining 339 news articles manually.

The following is an example of an article classified as $C_i = 1$, that is, an article containing positive information about the acquirer:

Standard & Poor’s Ratings Services assigned its ‘A’ senior unsecured debt rating to UnitedHealth Group Inc.’s $250 million, 3.75% notes maturing Feb 10, 2009, and $250 million, 4.75% notes maturing Feb. 10, 2014. The proceeds will be used to finance the cash portion of the acquisition of Mid Atlantic Medical Services Inc.

The rating reflects UNH’s extremely strong consolidated earnings profile as well as its very strong financial flexibility and business position. The business position is enhanced by good product and market diversification and the company’s unique competencies in specialized services. […]

An example of an article classified as containing negative information about the acquirer ($C_i = 0$) follows:

The modern personal computer is a technological marvel, but not such a good business proposition. Your desktop contains more computing power than mission control had for the Apollo moon landings, but the makers of the wizardry are laying off thousands of people and losing money. Hewlett-Packard Co. said this week that it would buy Compaq Computer Corp. in a bid to build a profitable business around the personal computer.
Street turned thumbs down immediately, knocking 18 percent off the value of H-P shares and 10 percent off Compaq shares. [...] 

After model estimation using the random sample of size 339, calculate posterior probabilities

\[ p_i := P(C_i = 1|F_{i,1} = f_{i,1}, \ldots, F_{i,2012} = f_{i,2012}) \] (13)

for all articles \( i = 1, \ldots, 82830 \). The probability \( p_i \) is calculated out-of-sample except for the small estimation sample.

The fourth and final step consists of aggregating text-based information pertaining to a given takeover attempt. Several news articles are written for each takeover attempt. Interest lies in a variable summarizing the financial media’s overall content for a given takeover. Letting \( S_a \subseteq \{1, \ldots, 82830\} \) denote the set of articles pertaining to takeover attempt \( a \), the variable \( \text{media} \) obtains as

\[ \text{media}_a := \frac{1}{|S_a|} \sum_{i \in S_a} p_i, \quad a = 1, \ldots, 348, \] (14)

where \( |\cdot| \) denotes the cardinality of a set. Figure 4 illustrates. By construction of the text document collection, it holds that \( S_{a_1} \cap S_{a_2} = \emptyset \) for all \( a_1 \neq a_2 \). This statement does not imply that no article pertains to more than one takeover. Instead it refers to the numbering of articles.

[Figure 4 about here.]

The variable \( \text{media} \) is the average over all posterior probabilities pertaining to a given takeover attempt. If the majority of news articles carries positive information about the acquirer, \( \text{media} \) is close to one. If most articles are negative, \( \text{media} \) is close to zero. The exclusion of the effective date or the date withdrawn ensures exogeneity.
of media with respect to the takeover outcome status. Section 9 also considers omitting more than one day in the construction of media.

### 7.2 Binary Outcome Model

Takeover outcome is a binary variable. To operationalize the empirical prediction from Section 5, consider the general binary outcome model

\[
P(\text{status}_a = \text{completed} \mid (\text{media}_a, \mathbf{x}_a)) = F((1, \text{media}_a, \mathbf{x}_a) \cdot \gamma). \tag{15}
\]

The function \( F \) is the inverse of the probit link, logit link, or complementary log-log link, that is, \( F(x) = \int_{-\infty}^{x} \phi(z)\,dz \), \( F(x) = e^x/(1 + e^x) \), or \( F(x) = 1 - \exp(-\exp(x)) \), respectively, where \( \phi \) is the probability density function of the standard normal distribution. \( \mathbf{x}_a \) is a \( 1 \times K \) vector of control variables, and \( \gamma \) is the \( (K + 2) \times 1 \) parameter vector to be estimated. If the empirical prediction of Section 5 holds, \( \gamma_2 \) is significant and positive, and the sample average of the marginal effect \( F'((1, \text{media}_a, \mathbf{x}_a) \cdot \gamma)\gamma_2 \) is positive.

### 8 Results

Figure 5 shows a model-free data visualization of how media relates to status. It confirms graphically that the empirical prediction of Section 5 holds. Positive news articles about the acquirer tend to precede successful takeovers. Vice versa, negative articles about the acquirer precede failed takeovers.

[Figure 5 about here.]
To ensure that this result is not caused by confounding variables, estimate model (15) with maximum likelihood. The control variables in $x_a$ include deal characteristics, acquirer and target firm characteristics, and $prevTakeovers$. The variable $prevTakeovers$ is included to account for the possibility that a takeover might be more likely to succeed during merger waves.

Figure 6 shows the estimated posterior probability of takeover success (probit), conditional on the media measure. Consistent with the empirical prediction, it shows that positive media content about the acquirer predicts takeover success and negative content predicts failure. All control variables except $media$ are fixed at their sample mean $\bar{x}$ to allow this two-dimensional representation of the estimated binary outcome model (15).

Because of the large number of potential explanatory variables, Table 3 shows the estimation results after a general-to-specific model selection procedure following a standard stepwise regression. This procedure provides a clear advantage over a “kitchen sink regression” or a manual elimination procedure that is subjective and ambiguous. At the beginning, all explanatory variables are included. In each following step, the least significant explanatory variable is dropped from the model and the model is then re-estimated. This iterative procedure stops when all explanatory variables are significant. Table 3 shows the model consisting of those explanatory variables that survive this stepwise regression. Throughout the stepwise regression, the $media$ variable is never among the least significant variables that are candidates for exclusion from the model.

[Table 3 about here.]
Three key findings obtain. First, both probit and logit specifications of the link function yield a highly significant and positive media coefficient. This result confirms this paper’s empirical prediction from Section 5. The average of the sample marginal effects are of similar magnitude in both model specifications. An increase in one unit of media yields an increase in approximately 0.25 units of the probability that the takeover succeeds. The estimated model coefficients of course differ in magnitude as a result of the different model specifications. This result is to be expected. Interpretation of coefficients outside the context of marginal effects is of limited value. Second, the addition of the single variable media to the model specification drastically increases goodness of fit. The inclusion of media raises the pseudo-$R^2$ by 42% and 38% compared to probit and logit models without media, respectively.

Third, only firm characteristics pertaining to the acquirer are significant while target firm characteristics are insignificant. This result confirms the game-theoretic model’s assumption that mainly uncertainty about the acquirer matters for shareholders’ decision on whether or not to approve the takeover. It shows that the informational asymmetry facing target shareholders mainly pertains to the acquirer and not to the target.

The number of observations in Table 3 is slightly smaller than the number of takeovers in the sample because of missing values in some firm characteristics. Missing values only pertain to the sub-sample of successful takeovers. This sub-sample is large relative to its complement (Table 2). Only a minimal amount of information is thus lost.

The remaining coefficients are as expected. If the acquirer has ample cash reserves, if its market value is high relative to its book value, or if the acquirer’s stock performs well prior to the takeover attempt, the takeover is likely to succeed. If the target
intends to exchange equity in itself for equity in the target or if the takeover attempt is un solicited, the takeover is likely to fail. Compared to unsuccessful takeover attempts, successful takeovers go along with a longer duration between announcement date and the date of resolution.

Figure 7 shows that \textit{prevTakeovers} captures the cyclical nature of merger activity. Still its coefficient is insignificant in Table 3. There are two potential explanations for this phenomenon. The first explanation is that factors causing a merger wave influence the decision on whether or not to start a takeover attempt ex ante only. Once the takeover attempt has started, other factors become important. That is, the factors causing a takeover wave lose their importance ex post. This explanation is supported by the marginal increase in pseudo-$R^2$ when including \textit{prevTakeovers} as an additional explanatory variable in model (15). Second, it is possible that the coefficient is insignificant because of the relatively small sample size.

[Figure 7 about here.]

9 Robustness Checks

Table 4 shows the results of robustness checks. The first robustness check in the columns labeled \textit{Probit} shows an alternative construction of the \textit{media} variable. As an alternative to (14), consider

\[
\text{média}_a := \text{median}_{i \in S_a} \{ p_i \}, \quad a = 1, \ldots, 348. \tag{16}
\]

Instead of aggregating text-based information pertaining to a given takeover using the mean, \textit{média} aggregates using the median. The result remains essentially unchanged.
The second robustness check in Table 4 shows an alternative specification of the inverse $F$ of the link function. The motivation for this alternative is as follows. Table 2 shows that only 8% of takeovers fail (status is withdrawn). That is, one outcome is rare. In such cases the complementary log-log model is appropriate. Its inverse of the link function is the cumulative distribution function of the extreme value distribution. It differs from the probit and logit models in being asymmetric around zero.

As with previous specifications, the coefficient of media is significant and positive. The complementary log-log model confirms the empirical prediction from Section 5. The main difference to Table 3 is that the averages of the sample marginal effects are larger in absolute value.

Finally, this paper’s result could be driven by information leakage. Information leakage means that some agents know the takeover’s outcome already a few days prior to the takeover’s resolution date and leak this information to the media. This consideration is related to reverse causality. The key difference is that information leakage is strategic. Since deal insiders know that target shareholders pay attention to information about the acquirer, insiders could leak information about the acquirer based on their knowledge about the takeover’s outcome. That is, although the media measure is unaffected by reverse causality, it could be affected by a correlation between (leaked) information about the acquirer and information about the takeover’s outcome.

Suppose that information leakage occurs. Deal insiders can only know the takeover’s outcome a few days prior to the resolution date. Information leakage is thus limited to a time period that immediately precedes the takeover’s resolution date. Omitting this time period in the construction of the media measure yields a measure unaffected by information leakage. That is, instead of omitting one day as shown in Figure 4,
omitting several days prior to the resolution date yields a measure that does not pick up leaked information. Thus, the following statement obtains:

**IL. If this paper’s result is driven by information leakage, then the goodness of fit of model (15) rapidly decreases as more days are omitted from the media measure prior to the resolution date.**

If (IL) holds, then the Pseudo-$R^2$ should rapidly decline to approximately 42%, which is the Pseudo-$R^2$ if the media measure is omitted from the probit specification. Figure 8 shows that omitting days in the construction of the media measure does not yield a meaningful decrease in Pseudo-$R^2$. For up to five weeks of omitted information, the Pseudo-$R^2$ stays above 60%. The (logically equivalent) contrapositive of (IL) thus implies that this paper’s result is not driven by information leakage.

Figure 8 even shows a slight increase in Pseudo-$R^2$ to 62% when more than seven days are omitted. That is, if this paper would discard information in Section 8, its result would even become stronger. This consideration shows that if information leakage occurs, deal insiders leak *misleading* information to the media.

[Figure 8 about here.]

10 Conclusion

This paper addresses the question of how important the media is for the likelihood of deal completion. Furthermore, it asks why rational target shareholders pay attention to the news, although they are fully aware that the media can be manipulated by deal insiders such as the acquirer (Ohl et al. (1995) and Ahern and Sosyura (2011)).
The results of this paper obtain by considering these questions from two angles. First, the theoretical model shows that there is a separating equilibrium in which different acquirers run different media strategies. This result endogenously gives meaning to media content and explains why target shareholders pay attention. The value-creating acquirer runs a media campaign to signal to target shareholders that the deal is good. The value-destroying acquirer has no incentives to run a media campaign because for him it is too costly. The reason why he is not willing to spend, say, $4 million on a campaign, but is willing to spend, say, $500 million on an acquisition is as follows: the $4 million are deadweight costs while spending $500 million gives the acquirer something of value (i.e. target stock). He has no incentives to burn $4 million because he cannot recover $4 million from deal completion. Even a value-destroying acquirer has incentives to bid as long as private benefits of control compensate for potential losses. Furthermore, the value-destroying acquirer speculates that the takeover succeeds because target shareholders may wrongly believe that the takeover creates value. This is possible because the media is a noisy signal. Second, the empirical part strongly confirms the empirical prediction derived from the theoretical model. It regresses takeover outcome on a novel media measure and controls. Consistent with theory, this yields a highly significant media coefficient. Positive media content about the acquirer predicts takeover success. Furthermore, the media’s marginal effect is large and the inclusion of the media measure strongly increases goodness of fit. This paper also considers alternative hypotheses such as reverse causality and information leakage by deal insiders. It does not find empirical support for these hypotheses.

This paper is the first to consider the effect of the media on takeover success in terms of deal completion. Deal completion is a (if not the) central concern in M&A dealmaking. Furthermore, this paper is the first to show why rational target shareholders pay
attention to the media, despite knowing that the media can be manipulated. Although
there are other potential signaling devices such as bid premium or advertising, nobody
can deny that the media plays a crucial role.

Similar to the early days of the capital structure literature, it is possible that there
are multiple theories that are consistent with the data, but so far have not yet been
discovered. By proposing and testing a first theory, this paper thus provides a starting
point for further research in this important area.

Appendix

Proof of Lemma 1. For all \( s \in \{0, 1\} \) consider the posterior

\[
\beta^s = P(T = H | S = s) = P(T = H | M = 1, S = s)P(M = 1 | S = s) + P(T = H | M = 0, S = s)P(M = 0 | S = s)
\]

\[
= P(T = H | M = 1, S = s)\frac{P(M = 1, S = s)}{P(S = s)} + P(T = H | M = 0, S = s)\frac{P(M = 0, S = s)}{P(S = s)}
\]

\[
= \frac{1}{P(S = s)} [P(T = H, M = 1, S = s) + P(T = H, M = 0, S = s)]
\]

\[
= \frac{1}{P(S = s)} [P(T = H, S = s | M = 1)P(M = 1) + P(T = H, S = s | M = 0)P(M = 0)].
\]

(17)

The distribution of \( S \) is conditional only on \( M \) and the distribution of \( M \) is conditional only
on \( T \). In particular, the distribution of \( S \) does not directly depend on \( T \). Thus, \( T \) and \( S \) are
independent conditional on \( M \). That is, \( P(T = t, S = s | M = m) = P(T = t | M = m)P(S = s | M = m) \).
Define
\[
\mu := P(M = 1) = P(M = 1|T = H)P(T = H) + P(M = 1|T = L)P(T = L)
= \xi_H \beta + \xi_L (1 - \beta),
\]
\[
\zeta := P(S = 1) = P(S = 1|M = 1)P(M = 1) + P(S = 1|M = 0)P(M = 0)
= \delta \mu + (1 - \delta)(1 - \mu). \tag{18}
\]
It follows that
\[
\beta_1 = \frac{1}{\zeta} \left[ P(S = 1|M = 1)P(T = H|M = 1)P(M = 1) 
+ P(S = 1|M = 0)P(T = H|M = 0)P(M = 0) \right]
= \frac{1}{\zeta} \left[ \frac{\delta P(M = 1|T = H)P(T = H)}{P(M = 1)}P(M = 1) 
+ (1 - \delta) \frac{P(M = 0|T = H)P(T = H)}{P(M = 0)}P(M = 0) \right]
= \frac{1}{\zeta} \left[ \delta \xi_H \beta + (1 - \delta)(1 - \xi_H) \beta \right] = \beta \cdot \frac{\delta \xi_H + (1 - \delta)(1 - \xi_H)}{\zeta}. \tag{19}
\]
The expression for \(\beta^0\) follows from an argument analogous to the derivation of \(\beta^1\). \qed

**Lemma 2 (Optimal Bid).** The acquirer bids \(b^* = p\) in equilibrium.

**Proof of Lemma 2.** Standing at the beginning of the game, the acquirer’s expected payoff is \(\pi\), defined by

\[
\pi^{t,s} := z(\mathbb{1}_{p \leq b \leq p^s} + \mathbb{1}_{p^s < b}) + (p_t - b)(k \mathbb{1}_{p \leq b \leq p} + n \mathbb{1}_{p < b < p^s}),
\]
\[
\pi^t := -c \xi_t + P(S = 0|T = t)\pi^{t,0} + P(S = 1|T = t)\pi^{t,1},
\]
\[
\pi := \beta \pi^H + (1 - \beta)\pi^L, \tag{20}
\]

38
where \( t \in \{H, L\} \) and \( s \in \{0, 1\} \). Bayes’ theorem implies
\[
P(S = s | T = t) = \frac{P(T = t | S = s)P(S = s)}{P(T = t)} \quad \forall t \in \{H, L\}, s \in \{0, 1\}.
\] (21)

With \( \beta^s \) and \( \zeta \) from the proof of Lemma 1, it follows that
\[
P(S = 1 | T = H) = \zeta \beta^1 / \beta = \xi_H \delta + (1 - \xi_H)(1 - \delta),
\]
\[
P(S = 0 | T = H) = (1 - \zeta)(1 - \beta^0 / \beta) = \xi_H (1 - \delta) + (1 - \xi_H) \delta,
\]
\[
P(S = 1 | T = L) = \zeta (1 - \beta^1) / (1 - \beta) = \xi_L \delta + (1 - \xi_L)(1 - \delta),
\]
\[
P(S = 0 | T = L) = (1 - \zeta)(1 - \beta^0) / (1 - \beta) = \xi_L (1 - \delta) + (1 - \xi_L) \delta.
\]
Thus, \( \pi \) as a function of \( b \) is piecewise linear and piecewise continuous. It is algebraically trivial to show that the only discontinuity occurs at \( b = p \) since the potential discontinuities originating from \( \pi^{H,s} \) and \( \pi^{L,s} \) at \( b = p^* > p \) cancel out for all \( s \in \{0, 1\} \).

\[\partial \pi / \partial b = 0 \text{ on } [0, p) \text{ and } \pi(b_2) < \pi(b_1) \text{ for all } b_1, b_2 \in [p, \infty) \text{ with } b_1 < b_2.\]

(The function \( \pi(b) \) is not necessarily differentiable on the whole interval \( (p, \infty) \) because of piecewise linearity.) Thus, \( b^* = p \) maximizes \( \pi \).

**Lemma 3.** It holds that \( 0 < \beta < \bar{\beta} < 1 \) and that \( c < \breve{c} \).

**Proof.** The first claim follows from \( p_L < p < p_H \) and \( \delta \in (1/2, 1) \). The second claim follows from \( -(p - p_L) < 0 < (p_H - p) \).

**Proof of Theorem.** Lemma 2 implies that \( \pi^{t,s} = [z + k(p_t - p)]1_{p \leq p^*} \) (see the proof of Lemma 2 for the definitions of \( \pi^{t,s} \) and \( \pi^t \)). The key to this proof is the acquirer’s expected profit \( \pi^t = \pi^t(\xi_H, \xi_L) \) at the point in time when it decides on the media strategy. The high type with objective function \( \pi^H \) plays against the low type with objective function \( \pi^L \). The goal is to find a perfect Bayesian equilibrium in this signaling game. That is, find a fixed point \( (\xi^*_H, \xi^*_L) \) such that
\[
\xi^*_H \in \text{argmax}_{\xi_H} \pi^H(\xi_H, \xi^*_L),
\]
\[
\xi^*_L \in \text{argmax}_{\xi_L} \pi^L(\xi^*_H, \xi_L),
\]
(22)
where $p^s$ in the function $\pi^t(\xi_H, \xi_L)$ is evaluated at $(\xi^*_H, \xi^*_L)$.

This proof’s focus is on the separating equilibrium. The pooling equilibrium follows from an analogous argument. Resolve shareholder indifference by letting shareholders tender if $p = p^s$. It holds that

$$
\beta \geq \beta \iff p \leq p^1|_{(\xi_H, \xi_L)=(1,0)},
$$

$$
\beta \geq \bar{\beta} \iff p \leq p^0|_{(\xi_H, \xi_L)=(1,0)}.
$$

(23)

Let $\beta \in [\beta, \bar{\beta})$. Then $p^0|_{(\xi_H, \xi_L)=(1,0)} < p \leq p^1|_{(\xi_H, \xi_L)=(1,0)}$ holds. If the acquirer thus plays $(\xi_H, \xi_L) = (1,0)$, then shareholders tender after observing $s = 1$ and they do not tender after observing $s = 0$. With $p^s = p^s|_{(\xi_H, \xi_L)=(1,0)}$, it follows that

$$
\pi^L(1,1) \leq \pi^L(1,0) \iff c \geq \underline{c},
$$

$$
\pi^H(0,0) \leq \pi^H(1,0) \iff c \leq \bar{c}.
$$

(24)

Since with $p^s = p^s|_{(\xi_H, \xi_L)=(1,0)}$ it holds that $\pi(\xi_H, \xi_L)$ is linear in $\xi_H$ and $\xi_L$, the desired result follows.

References


The variables *media* and *média* show how positive or negative news articles are about the acquirer. A value close to one indicates that most articles are positive about the acquirer. A value close to zero indicates that most articles are negative. Sections 7.1 and 9 detail the construction of *media* and *média*, respectively. *aCash* denotes the acquirer’s cash and the temporary investment vehicles for cash, including commercial paper and short-term government securities, as of the date of the most current financial information prior to the announcement of the transaction (mil. $). *aBookToMarket* is the book-to-market ratio of the acquirer. *aReturn* is the acquirer’s share price return between the announcement date and the date four weeks prior to announcement. *days* is the number of days between announcement date and effective date in case of takeover success or date withdrawn in case of takeover failure. The columns labeled $P_k$ show the $k$th percentile. The column labeled *Std. Dev.* shows the standard deviation.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min</th>
<th>$P_{25}$</th>
<th>Mean</th>
<th>Median</th>
<th>$P_{75}$</th>
<th>Max</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>media</td>
<td>0.06</td>
<td>0.92</td>
<td>0.92</td>
<td>0.97</td>
<td>0.99</td>
<td>1.00</td>
<td>0.14</td>
</tr>
<tr>
<td>média</td>
<td>0.00</td>
<td>1.00</td>
<td>0.97</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.17</td>
</tr>
<tr>
<td>aCash (mil. $)</td>
<td>0.67</td>
<td>125.02</td>
<td>1418.03</td>
<td>420.73</td>
<td>1255.78</td>
<td>21971.00</td>
<td>2683.20</td>
</tr>
<tr>
<td>aBookToMarket</td>
<td>0.00</td>
<td>0.13</td>
<td>0.35</td>
<td>0.27</td>
<td>0.46</td>
<td>2.64</td>
<td>0.34</td>
</tr>
<tr>
<td>aReturn</td>
<td>-0.67</td>
<td>-0.08</td>
<td>-0.01</td>
<td>-0.01</td>
<td>0.06</td>
<td>0.61</td>
<td>0.17</td>
</tr>
<tr>
<td>days</td>
<td>1.00</td>
<td>74.00</td>
<td>129.43</td>
<td>101.00</td>
<td>161.00</td>
<td>764.00</td>
<td>90.62</td>
</tr>
</tbody>
</table>
status indicates whether the target or acquirer has terminated its agreement, letter of intent, or plans for the acquisition or merger or whether the transaction has closed. stockSwap indicates whether or not the acquiring company exchanges equity in itself for equity in the target. The acquirer must be acquiring at least 50% of the target’s equity or be acquiring the remaining interest up to 100% of the target’s equity, and at least 50% of the consideration offered must be in the form of equity. unsolicited indicates whether or not an acquiring company makes an offer for another company without prior negotiations.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levels</th>
<th>Observations</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>status</td>
<td>withdrawn</td>
<td>28</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>completed</td>
<td>320</td>
<td>92.0</td>
</tr>
<tr>
<td>stockSwap</td>
<td>no</td>
<td>134</td>
<td>38.5</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>214</td>
<td>61.5</td>
</tr>
<tr>
<td>unsolicited</td>
<td>no</td>
<td>322</td>
<td>92.5</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>26</td>
<td>7.5</td>
</tr>
</tbody>
</table>
Table 3: Media Content Predicts Takeover Outcomes

This table shows the results of maximum likelihood estimation of model (15). The dependent variable equals one if the takeover status is completed and zero if it is withdrawn. Independent variables are described in Tables 1 and 2. The first row shows the specification of the link function. Columns labeled Coeff. show the estimated model coefficients, columns labeled Marg. Effect show the average of the sample marginal effects. “= yes” indicates the inclusion of a dummy variable with value equal to one if the nominal variable is equal to yes and zero otherwise. \(t\) statistics are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively. The last two rows show McFadden’s pseudo-\(R^2\) and the number of observations.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Probit</th>
<th>Logit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-5.85***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-3.10)</td>
<td>(-2.98)</td>
</tr>
<tr>
<td>media</td>
<td>4.69***</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td>(4.99)</td>
<td>(4.88)</td>
</tr>
<tr>
<td>log(aCash)</td>
<td>0.23**</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>(2.53)</td>
<td>(2.68)</td>
</tr>
<tr>
<td>aBookToMarket</td>
<td>-1.45***</td>
<td>-0.09</td>
</tr>
<tr>
<td></td>
<td>(-3.34)</td>
<td>(-3.16)</td>
</tr>
<tr>
<td>aReturn</td>
<td>3.43***</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>(3.30)</td>
<td>(3.16)</td>
</tr>
<tr>
<td>stockSwap = yes</td>
<td>-1.64***</td>
<td>-0.10</td>
</tr>
<tr>
<td></td>
<td>(-2.80)</td>
<td>(-2.80)</td>
</tr>
<tr>
<td>unsolicited = yes</td>
<td>-2.10***</td>
<td>-0.13</td>
</tr>
<tr>
<td></td>
<td>(-4.12)</td>
<td>(-4.04)</td>
</tr>
<tr>
<td>log(days)</td>
<td>0.97***</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>(3.12)</td>
<td>(2.90)</td>
</tr>
<tr>
<td>Pseudo-(R^2)</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>332</td>
<td></td>
</tr>
</tbody>
</table>

\[ t \text{ statistics are in parentheses. } *, **, \text{ and } *** \text{ indicate significance at } 10\%, 5\%, \text{ and } 1\%, \text{ respectively.} \]
Table 4: Robustness Checks of Effect of Media on Takeover Outcome

The dependent variable equals one if the takeover status is completed and zero if it is withdrawn. Independent variables are described in Tables 1 and 2. The first row shows the specification of the link function. Columns labeled Coeff. show the estimated model coefficients, columns labeled Marg. Effect show the average of the sample marginal effects. “= yes” indicates the inclusion of a dummy variable with value equal to one if the nominal variable is equal to yes and zero otherwise. t statistics are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively. The last two rows show McFadden’s pseudo-$R^2$ and the number of observations.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Probit</th>
<th>Complementary Log-Log</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-5.35***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.90)</td>
<td></td>
</tr>
<tr>
<td>media</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>média</td>
<td>3.66***</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>(4.63)</td>
<td></td>
</tr>
<tr>
<td>log(aCash)</td>
<td>0.26***</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>(2.77)</td>
<td></td>
</tr>
<tr>
<td>aBookToMarket</td>
<td>-1.51***</td>
<td>-0.10</td>
</tr>
<tr>
<td></td>
<td>(-3.39)</td>
<td></td>
</tr>
<tr>
<td>aReturn</td>
<td>3.52***</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>(3.32)</td>
<td></td>
</tr>
<tr>
<td>stockSwap = yes</td>
<td>-1.60***</td>
<td>-0.10</td>
</tr>
<tr>
<td></td>
<td>(-2.83)</td>
<td></td>
</tr>
<tr>
<td>unsolicited = yes</td>
<td>-2.61***</td>
<td>-0.17</td>
</tr>
<tr>
<td></td>
<td>(-5.06)</td>
<td></td>
</tr>
<tr>
<td>log(days)</td>
<td>0.99***</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>(3.13)</td>
<td></td>
</tr>
<tr>
<td>Pseudo-$R^2$</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>332</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1: Timeline of Takeover Game

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquirer starts takeover and makes bid $b$</td>
<td></td>
</tr>
<tr>
<td>Acquirer decides on media campaign $\xi_t$</td>
<td></td>
</tr>
<tr>
<td>Realization of noisy media signal $s$; shareholders update to posterior belief $\beta^s$</td>
<td></td>
</tr>
<tr>
<td>Shareholders decide whether to tender</td>
<td></td>
</tr>
<tr>
<td>Takeover success or failure; uncertainty about acquirer’s type is resolved</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: Shareholders’ Posterior Belief

This figure shows target shareholders’ posterior belief $\beta^1$ after the shareholders observe a noisy media signal that indicates the occurrence of a media campaign run by the acquirer. The posterior $\beta^1$ is a function of $\xi_H$ and $\xi_L$. For all $t \in \{H, L\}$, $\xi_t$ is the probability that the acquirer of type $t$ runs a media campaign. A value of $\beta^1$ close to one means that target shareholders believe the acquirer creates value (i.e. the acquirer is of type $H$). A value of $\beta^1$ close to zero means that shareholders believe the acquirer destroys value (i.e. the acquirer is of type $L$).
Figure 3: Conditional Dependencies of Naïve Bayes
Using a path diagram, this figure shows the conditional dependencies of random variables in the naïve Bayes model. The variable $C_i$ denotes the content of press article $i$. This content directly influences how often various words (terms) occur in the article. The variables $F_{i,1}, \ldots, F_{i,2012}$ denote the frequencies of 2012 important words in the article. Section 7 details how this word list is obtained. The $F_{i,k}$’s can be zero, so naïve Bayes can deal with long and short press articles.

Figure 4: Media Measure Is Predetermined
Using a timeline, this figure visualizes the construction of the media measure. The media measure includes press articles that mention the name of the acquirer and the target within the first one hundred words of the article. Furthermore, the measure only includes those articles that appear on or after the announcement date and on or before the prior day to the resolution date (i.e. effective date or date withdrawn). Because the media measure omits one day prior to the deal’s resolution date, it is predetermined with respect to the takeover’s outcome. Section 9 considers robustness checks and omits up to 35 days prior to the resolution date.
Figure 5: Positive News Articles About Acquirer Entail Takeover Success
This figure shows that positive news articles about the acquirer (\textit{media} is large) precede successful takeovers. Vice versa, negative articles about the acquirer (\textit{media} is small) precede failed takeovers. The figure groups \textit{media} in intervals and produces a spine plot for the resulting proportions of \textit{status} within the \textit{media} groups. Dark areas correspond to successful takeovers (\textit{status is completed}). Light areas correspond to failed takeovers (\textit{status is withdrawn}). The horizontal axis is distorted. The width of each \textit{media} group is proportional to the corresponding number of observations. The large dark area on the right-hand side follows from the large amount of successful takeovers coinciding with \textit{media} $\in [0.9, 1]$. 

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure5.png}
\caption{Spine plot showing the relationship between media and status.}
\end{figure}
Figure 6: Estimated Probit Model Confirms Empirical Prediction

This plot shows that deal completion strongly depends on the media measure. It visualizes the posterior probability of deal completion from the estimation results of Table 3’s probit model as a function of the media measure. A media measure close to one means that the media is very positive about the acquirer. This implies that the deal is going to succeed almost with certainty. Vice versa, a media measure close to zero implies that the takeover is going to fail with around 80% probability. The control variables $\bar{x}$ have been fixed at their sample averages $\bar{x}$ in this figure.

$$P(\text{status}_a = \text{completed} \mid (\text{media}_a, \bar{x}))$$
Figure 7: Merger Waves

This figure shows how the variable \textit{prevTakeovers} changes over time. \textit{prevTakeovers} shows for each takeover attempt the number of successful takeovers in the previous 100 days. The figure shows the peak of the merger wave in 2000, the subsequent decline, and the resumption of merger activity starting in 2003.
Figure 8: Deal Insiders Leak Misleading Information

This figure shows that goodness of fit does not decrease significantly, although the media measure contains less current information. This implies that this paper’s results cannot be explained by information leakage or reverse causality. To arrive at this conclusion, this figure shows the pseudo-$R^2$ of a probit model as a function of the way the media measure is constructed. The probit model regresses takeover outcome on the media measure and controls. The construction of the measure changes by varying the number of days omitted prior to deal resolution (Figure 4).