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Do Managers Disclose or Withhold Bad News? Evidence from Short Interest

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ABSTRACT: Prior studies provide conflicting evidence as to whether managers have a general tendency to disclose or withhold bad news. A key challenge for this literature is that researchers cannot observe the negative private information that managers possess. We tackle this challenge by constructing a proxy for managers' private bad news (residual short interest) and then perform a series of tests to validate this proxy. Using management earnings guidance and 8-K filings as measures of voluntary disclosure, we find a negative relation between bad-news disclosure and residual short interest, suggesting that managers withhold bad news in general. This tendency is tempered when firms are exposed to higher litigation risk, and it is strengthened when managers have greater incentives to support the stock price. Based on a novel approach to identifying the presence of bad news, our study adds to the debate on whether managers tend to withhold or release bad news.

Data Availability: Data used in this study are available from public sources identified in the study.

Keywords: earnings guidance; 8-K filings; voluntary disclosure; short interest; short selling.

I. INTRODUCTION

Prior studies provide conflicting evidence on managers' tendency to disclose or withhold bad news. While some studies contend that litigation risk and reputational concerns motivate managers to release bad news quickly (Kasznik and Lev 1995; Skinner 1994, 1997), others posit that career concerns and personal wealth at stake encourage managers to withhold bad news (Kothari, Shu, and Wysocki 2009). A key challenge in testing these ideas empirically is that researchers cannot observe managers' private information prior to voluntary disclosure. Kasznik and Lev (1995), who study the managerial disclosure of bad news by linking managerial guidance with *ex post* earnings surprises, rely on two critical assumptions: first, that managers possess full information about true earnings when they issue earnings guidance earlier in the year, and second, that managerial guidance does not affect the magnitude and direction of earnings surprises. Kothari et al. (2009), in contrast, infer how fast managers release bad news by comparing stock market reactions to good-news versus bad-news corporate events, and they interpret a larger response to bad news as an indication that managers hide and accumulate bad news before

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releasing it all at once. Greater market reaction to bad news than to good news, however, might arise because of investors' asymmetric loss function or errors in their expectations.

In this paper, we tackle this challenge and provide more clarity on the managerial practice of bad-news disclosure by using the level of short interest as a proxy for the existence and the extent of managers' private bad news. Prior studies provide strong evidence that high short interest is a reliable predictor of negative information that is yet to be reflected in stock prices: high short interest predicts negative future stock returns (Asquith and Meulbroek 1995; Desai, Ramesh, Thiagarajan, and Balachandran 2002), future stock price crash risk (Callen and Fang 2015), negative earnings surprises (Christophe, Ferri, and Angel 2004), and analyst downgrades (Christophe, Ferri, and Hsieh 2010). Recent studies also find that managers and short sellers share negative private information. Khan and Lu (2013) find significant increases in short sales immediately before large insider sales, but not before small insider sales. They contend that their results are not driven by public information, but instead are facilitated by information leaked by managers to short sellers. Massa, Qian, Xu, and Zhang (2015) find that the presence of short sellers induces insiders to sell more and trade faster to preempt competition from short sellers, suggesting that short sellers and managers share the same negative private information. We, therefore, posit that managers of firms with higher short interest, on average, possess more negative private information than do those of firms with lower short interest and test whether these managers are more or less likely to disclose bad news compared to managers of other firms. More specifically, we construct a residual measure of the short interest level that is purged of factors that are not reflective of bad news, namely, the difficulty to short (i.e., the availability of loanable shares), hedging-based shorting, and a market-wide increase in shorting over time.

We conduct several tests to validate residual short interest as a proxy for the negative information that managers possess, but that is not yet reflected in stock prices. First, we show that high residual short interest at the end of quarter t is a strong predictor of negative abnormal stock returns over quarters t+1 to t+4, suggesting that residual short interest at a given point in time contains "private" bad news that becomes public only over the subsequent quarters. We also find that once managers announce bad news in quarter t+1, the extent to which residual short interest can predict stock returns over the subsequent three quarters weakens substantially, indicating that information reflected in residual short interest overlaps with managers' private bad news conveyed by disclosure. Second, we examine the association of residual short interest with two managerial actions, namely, insider trading and stock repurchases, which are less frequently observed than short interest, but are nevertheless possible indicators of managers' private information. We use Cohen, Malloy, and Pomorski's (2012) methodology to identify opportunistic insider trading and show that residual short interest is negatively associated with top corporate officers' opportunistic net buying. Residual short interest is also negatively related to the likelihood of stock repurchase programs. To the extent that insider net buying and stock repurchases reflect managers' private good news, the negative relation between residual short interest and these two measures validates residual short interest as a proxy for managers' private bad news.

Turning to our main analysis, we examine the relation between residual short interest at the end of a quarter and the frequency of managers' voluntary bad-news disclosure in the subsequent quarter. Following prior studies (e.g., Balakrishnan, Core, and Verdi 2014; Guay, Samuels, and Taylor 2016; Cooper, He, and Plumlee 2018), we use two measures of voluntary disclosure. The first measure is based on management earnings guidance.[1] We determine the nature of such guidance by comparing guided earnings numbers to the prevailing consensus analyst forecasts. The second measure is based on voluntary 8-K filings. We rely on the market reaction to 8-K filings to infer the nature of the news. Using (pooled) cross-sectional data, we find that residual short interest is negatively associated with the frequency of bad-news earnings guidance and voluntary 8-K filings, suggesting that managers, in general, withhold bad news. The economic significance of the effect of residual short interest on disclosure is comparable to that of key disclosure determinants identified in prior studies, such as return volatility and operating performance (e.g., Waymire 1984; Kothari et al. 2009).

We take several steps to address potential endogeneity concerns. First, we exploit firm fixed effects to address any potential concerns related to correlated omitted variables. We find that the negative relation between residual short interest and the frequency of bad-news disclosures remains significant in the firm fixed effect models, suggesting that our results are not driven by time-invariant firm-specific factors. Second, we conduct a placebo test, in which we replace bad-news disclosure with good-news disclosure as our dependent variable. We find that the relation between residual short interest and good-news disclosure is insignificant, which alleviates the concern that the negative association between residual short interest and bad-news disclosure reflects a general association between the former and the firm's disclosure policy.

Third, we examine how two managerial incentives—litigation risk and managerial equity incentives—affect the relation between residual short interest and bad-news disclosure. Consistent with litigation concerns constraining managers' tendency to withhold bad news, we find that the negative association between residual short interest and frequency of bad-news disclosure

[1] Earnings guidance may take the form of any manager-provided information that guides outsiders (both directly and indirectly) in their assessment of a firm's future earnings (Miller 2002). In this paper, however, earnings guidance refers only to explicit earnings forecasts issued by managers.

is more pronounced for firms with lower litigation risk. We also find that managers are more inclined to withhold bad news when their equity portfolio value is more sensitive to changes in the firm's stock price. The systematic cross-sectional variation in the relation between residual short interest and bad-news disclosure strengthens our inference that managerial incentives, rather than unknown omitted variables, underpin our results.

Finally, we use Regulation SHO (hereafter, Reg SHO) to examine how an exogenous shock to short sale constraints affects the relation between residual short interest and bad-news disclosure. Reg SHO, which relaxed the uptick rule for randomly selected "pilot" stocks, serves as a (positive) shock to short sellers' ability to trade on private bad news, and hence to the amount of bad news captured by short interest. We, therefore, predict that the association between residual short interest and bad-news disclosure will be stronger among pilot stocks relative to other stocks. Based on a difference-in-differences design, we find that Reg SHO indeed strengthens the negative relation between residual short interest and bad-news disclosure for pilot stocks during the test period.

Two recent papers examine the effect of *ex ante* short sale constraints on voluntary disclosure. Both rely on Reg SHO to study how a reduction in short sale constraints affects disclosure, but they arrive at somewhat conflicting conclusions. While Li and Zhang (2015) conclude that firms subject to the reduced constraints obscure their bad-news disclosure, Clinch, Li, and Zhang (2016) assert that such firms accelerate the release of bad-news management forecasts. Our paper differs from these studies in that we look at the *ex post* realized level of short interest. While *ex ante* short sale constraints determine the maximum potential impact that short sellers may have on firm behavior or stock price, the *potential* is converted into *actual* short selling only if short sellers believe that they possess negative private information about the firm. *Actual* realized short selling, as opposed to short sale *constraints per se,* is, therefore, a more suitable proxy for the existence of privately held bad news.

Our paper makes several important contributions. First, we address a key challenge that researchers face in providing evidence on bad-news disclosure by developing and validating a proxy designed to capture the existence and extent of managers' negative private information. Our results show that managers, *in general,* withhold bad news, although there is significant heterogeneity in this tendency across firms, depending on the firms' respective litigation risks and managers' equity incentives. Our findings, therefore, add novel evidence to the debate on whether managers have a general tendency to disclose or withhold information when they possess bad news. Second, the proxy that we develop for managers' negative private information offers a broad methodological contribution, in that researchers can potentially employ this measure in other settings. For example, one could use the proxy to examine the accounting choices or investment behavior of managers who possess negative private information about a firm's future prospects. Third, our finding of managers' reluctance to disclose bad news in the face of high short interest has practical significance for some investors, for example, those that hold long positions in stocks.

The rest of the paper is organized as follows. Section II discusses prior studies that provide opposing views as to whether managers disclose or withhold bad news and presents our key empirical predictions. Section III describes the data, introduces our measures, and validates residual short interest as a proxy for managers' negative private information. Section IV outlines the research design for our main analysis and presents the main results. Section V discusses the additional analyses. Section VI concludes the paper.

II. PRIOR LITERATURE AND EMPIRICAL PREDICTIONS

Many factors contribute to managers' incentives to disclose or withhold bad news from the market. On the one hand, managers may be motivated to release bad news quickly when they face litigation risk and reputational concerns. Class action lawsuits that are brought out by Rule 10b-5 of the Securities Exchange Act of 1934 typically allege that managers made false or misleading statements and/or failed to disclose adverse material information in a timely manner to the market, resulting in the firm's stock price being artificially inflated (Billings and Cedergren 2015). Investors who buy stocks with inflated prices might have avoided the loss if the bad news had been disclosed in a timely manner. Lev (1992) and Skinner (1994, 1997) suggest that litigation risk motivates managers to disclose bad news quickly. The full disclosure theory also suggests that the threshold level of disclosure collapses to the least favorable possible information (Grossman 1981; Milgrom 1981; Verrecchia 1983), implying that managers are always better off disclosing bad news, as long as the bad news is better than the least favorable possible information. Kasznik and Lev (1995) show that firms facing earnings disappointments are more likely to issue earnings warnings.

On the other hand, Kothari et al. (2009) argue that career concerns and personal financial gains provide incentives for managers to withhold bad news, with the hope that subsequent events will turn in their favor and bury the bad news. To test their hypothesis empirically, Kothari et al. (2009) examine stock price reactions to announcements of good and bad news related to two corporate events: dividend changes and management earnings guidance. Using (pooled) cross-sectional data, they find that stock price reactions to bad-news corporate events are asymmetrically larger than those to good-news corporate

events. They interpret this evidence to mean that managers, on average, hoard bad news and release it all at once when it crosses a certain threshold, causing a large negative stock price reaction.

The question is: which incentive (i.e., the incentive to disclose or the incentive to withhold bad news) dominates the other? Prior studies provide mixed evidence. While Kasznik and Lev (1995) report that firms facing earnings disappointments are more likely to disclose, implying a general managerial tendency to disclose bad news in a timely manner, Kothari et al. (2009) conclude that management, on average, withholds bad news. Understanding the managerial tendency to disclose or withhold bad news is important, because a delay in bad-news disclosure increases information asymmetry and leads the firm's information environment to deteriorate. Prior studies also suggest that failure to disclose bad news is responsible for stock price crashes, which impose great wealth losses on investors (Kim, H. Li, and S. Li 2014; Kim and Zhang 2016; Bao, Fung, and Su 2018).

A challenge faced by studies examining bad-news disclosure is that researchers cannot observe the presence and nature of private information that is yet to be disclosed. Prior studies take different approaches to tackle this challenge. Kasznik and Lev (1995), for example, study whether managers warn investors before large earnings surprises. They document that managers are more likely to issue guidance before earnings disappointments than before positive earnings surprises, and that larger disappointments are preceded more often by quantitative guidance than by soft disclosure. To draw their key inferences, they associate the earnings surprises with managers' tendency to issue guidance. There are at least two potential problems with this approach. First, the information set immediately before the earnings announcement could be very different from the information set that managers possess earlier in the fiscal period, when they decide to warn or not. Second, and perhaps more important, management earnings guidance may affect the direction and the magnitude of earnings surprises at the time of the earnings announcement. Management earnings guidance may influence managerial incentives to engage in earnings management (Kasznik 1999; Matsumoto 2002). Earnings management, in turn, will affect the actual earnings announced and the magnitude of earnings surprises. Thus, earnings surprises of firms that do not issue earnings guidance are not comparable to earnings surprises of firms that issue earnings guidance. Alternatively, Kothari et al. (2009) attempt to infer the managerial practice of bad-news disclosure based on stock price responses to good-news and bad-news corporate events. They interpret the greater stock price response to bad news as evidence of bad-news hoarding. Greater market reaction to bad news, however, could be due to investors' asymmetric loss function (see, for example, Barberis and Huang 2001; Hirshleifer and Teoh 2009) or investors' expectation errors (Skinner and Sloan 2002).[2]

In this study, we develop a novel proxy for the existence and the extent of negative private information that managers possess and reexamine the general managerial tendency to disclose or withhold bad news. Following prior studies (e.g., Kasznik and Lev 1995; Kothari et al. 2009), we focus on the heterogeneity of disclosure practices across firms, conditional on managers' negative private information. If managers withhold (disclose) bad news in general, then we predict a negative (positive) relation between bad-news disclosure and our proxy for managers' negative private information.

III. DATA, MEASURES, AND VALIDATION TESTS

Sample Selection and Data

Our sample period begins in 2001 because the passage of Regulation Fair Disclosure (hereafter, Reg FD) in 2000 changed firms' incentives for disclosure (Kross and Suk 2012; Kim and Song 2015). We end our sample period in 2010, because Thomson Financial temporarily suspended the Company Issued Guidance (CIG) dataset in 2011 and later changed how it compiles management guidance, one of the disclosure proxies that we use.

Appendix A outlines our sample selection process. We begin with all firm-quarter observations of common stocks (stock codes 10 or 11) listed in NYSE/AMEX and NASDAQ between 2001 and 2010, with non-missing returns, price, SIC code, and shares outstanding data from CRSP. We drop observations with a stock price below $1 because of the problem of stale prices (Berkman, Dimitrov, Jain, Koch, and Tice 2009) and because such stocks are extremely difficult to short (D'Avolio 2002; Christophe et al. 2004). We merge the remaining firm-quarter observations with monthly short interest data, obtained from the Compustat Short Interest File for NYSE/AMEX stocks and directly from the exchange for NASDAQ stocks. Short interest represents the total number of uncovered shares sold short at a particular point in time, usually on or before the 15th day of a month.[3] We drop those observations for which we could not find data on short interest, leaving 170,887 firm-quarter observations (Step 3 in Appendix A). After excluding observations with missing control variables, we use 163,211 firm-quarter

[2] Skinner and Sloan (2002) find that growth stocks exhibit an asymmetrically large negative price response to negative earnings surprises. They attribute this to investors' overoptimistic expectations, which are corrected through subsequent negative news.

[3] The data are available at a monthly frequency for the period before 2007 and twice a month afterward. For consistency, we ignore the values of short interest reported in the second half of each month during the latter period.

observations (Step 4 in Appendix A) to estimate residual short interest, our proxy for managers' negative private information. We then merge residual short interest with control variables constructed from Compustat, CRSP, I/B/E/S, and the Thomson-Reuters 13F database for the accounting, market, analyst, and institutional ownership data, respectively. This results in 152,614 firm-quarter observations, which we use to conduct the validation tests of residual short interest (Step 5 in Appendix A). We label this as the validation sample.

We use two measures of voluntary disclosure—management earnings guidance and voluntary items in 8-K filings—to test managers' tendency to disclose or withhold bad news. For the test of management guidance, we remove firms that do not issue any earnings guidance in the previous four quarters to minimize the heterogeneity of disclosure policy across firms (Houston, Lev, and Tucker 2010; Kim, Su, and Zhu 2017). We refer to this sample as the management guidance sample (Step 6a in Appendix A). For the test of voluntary 8-K disclosure, we limit our sample period to 2004Q4–2010Q4. The Securities and Exchange Commission (SEC) mandated new disclosure requirements for 8-K filings on August 23, 2004, which expanded the list of items that must be reported and accelerated the deadlines for these reports (Lerman and Livnat 2010). As such, the items reported in pre-rule 8-Ks differ in both form and substance from those in post-rule 8-Ks (Cooper et al. 2018). To ensure the consistency of 8-K items, we start our 8-K disclosure analysis from the fourth quarter of 2004 and continue to the end of 2010. We restrict our sample to firms that issue at least one 8-K with voluntary items in the sample period (Step 6b in Appendix A).[4] We refer to this sample as the 8-K disclosure sample.[5]

Measures of Managerial Disclosure of Bad News

We construct two proxies for voluntary disclosure: management guidance and voluntary items in 8-K filings. Management guidance is a common measure of voluntary disclosure used by prior studies (e.g., Balakrishnan et al. 2014). We include range and point estimates of both annual and quarterly earnings guidance. For open (closed) range earnings guidance, we follow Kim and Park (2012) and take the maximum or minimum (midpoint) value as the guided number. We exclude qualitative guidance because we cannot compare it with the consensus analyst forecast to determine whether it represents good or bad news.[6] As we are interested in the tendency of bad-news disclosure, we determine the nature of guidance by comparing the guided earnings numbers with those of prevailing consensus analyst forecasts. If the guided earnings number is lower than the most recent consensus analyst forecast, then we define the guidance as bad-news guidance. The converse is true for good-news guidance. We count the frequency of bad-news guidance in a quarter and label it *FREQ_BAD_MG*.

Because many firms do not issue management guidance, we construct a second disclosure proxy based on 8-K filings. The analyses based on 8-K filings include a broader set of firms, as all public firms file 8-Ks. Prior research identifies three 8-K filing items as voluntary: item 2.02—"Results of Operations and Financial Condition"; item 7.01—"Regulation FD Disclosure"; and item 8.01—"Other Events" (Lerman and Livnat 2010; Cooper et al. 2018). We rely on the sign of the three-day abnormal return around the filing date of the 8-K containing these items to determine whether the disclosure conveys good or bad news. To accurately ascribe the stock market reaction to the voluntary 8-K items, we exclude those observations where the three-day return window around the filing date overlaps with the filing date of 8-Ks containing mandatory items (except for item 9.01)[7] or the filing date of the mandatory 10-Q or 10-K reports.

8-K item 2.02 frequently includes an earnings announcement, in addition to voluntary disclosure such as the quarterly outlook. We control for the effect of the earnings announcement by regressing market-adjusted announcement returns on the earnings surprise and take the residuals. We also control for the differences in the expected returns across stocks with high and low short interest. Prior studies show that expected returns are systematically more negative for stocks with high short interest than for the stocks with low short interest (Asquith and Meulbroek 1995; Desai et al. 2002; Boehmer, Huszar, and Jordan 2010). Controlling for the effect of short interest level on expected, or normal, returns allows us to isolate the abnormal stock returns that can be attributed to the announcement of 8-K disclosure. We also control for the interaction effect of the earnings announcement and the level of short interest. Prior work by Lasser, Wang, and Zhang (2010) and Hong, Kubik, and Fishman

[4] Because firms frequently change earning guidance policies (Houston et al. 2010; Kim et al. 2017), we impose a more restrictive criterion on the management guidance sample. Considering that a broader set of firms issue 8-Ks with voluntary items and that there is no empirical evidence that firms change their 8-K disclosure policies frequently, we do not limit the 8-K sample to firms that issue at least one voluntary 8-K in the previous four quarters. If we impose this restriction, then we have 88,930 observations and the (untabulated) results are qualitatively the same.

[5] The management guidance sample and the 8-K disclosure sample consist of 49,393 and 90,265 firm-quarter observations, respectively, with an overlap of 29,660 observations. When we limit the guidance sample to the same period as the 8-K sample (2004Q4 to 2010Q4), we have 29,777 observations, of which 29,660 observations also belong to the 8-K disclosure sample.

[6] Qualitative guidance comprises about 2.6 percent of all guidance issued by our sample firms. In a robustness check, we include qualitative guidance and use stock returns around the guidance announcements to classify it as good- or bad-news guidance. The results are qualitatively similar to those tabulated based only on quantitative guidance.

[7] Item 9.01, "Financial Statements and Exhibits," is a mandatory item that is typically filed together with other 8-K items and is not considered as a standalone item (e.g., Lerman and Livnat 2010). We, therefore, do not remove a voluntary 8-K item when it is filed together with item 9.01.

(2012) show that for heavily shorted stocks, short sellers attempt to cover (increase) their short positions in response to positive (negative) earnings surprises, resulting in greater market reaction to the same amount of earnings surprises. We, therefore, include the interaction term to control for the differential stock price reaction to earnings surprises for stocks with high short interest. Not controlling for these confounding effects can lead to incorrect inferences about the nature of the news conveyed by 8-K disclosures in our context. Specifically, we estimate the following regression to estimate the abnormal announcement returns associated with 8-K item 2.02:

$$CAR_{i,k,t+1} = \alpha + \beta_1 ES_{i,k,t+1} + \beta_2 SI_{i,t} + \beta_3 ES_{i,k,t+1} \times SI_{i,t} + \varepsilon_{i,k,t+1} \quad (1)$$

where *i, k,* and *t* represent firm, item 2.02 filed in an 8-K, and quarter, respectively. *CAR* is the three-day market-adjusted return around the filing of item 2.02, calculated as a firm's raw returns minus returns on the CRSP value-weighted market index over three days around the filing; *ES* is the earnings surprise, scaled by stock price if firm *i* announces earnings during the three-day window around the filing of item 2.02, and 0 otherwise; and *SI* is the most recent quarter-end raw short interest, scaled by total shares outstanding. Appendix B provides the variable definitions in detail.

For the other two voluntary 8-K items (i.e., items 7.01 and 8.01), we estimate the following regression, as earnings announcements do not accompany 7.01 and 8.01 disclosures:

$$CAR_{i,k,t+1} = \alpha + SI_{i,t} + \varepsilon_{i,k,t+1} \quad (2)$$

As noted earlier, regressing *CAR* on short interest allows us to control for differences in the expected returns across stocks with high and low short interest.[8] Equation (1) and Equation (2) are estimated cross-sectionally for each calendar quarter. A bad-news (good-news) 8-K disclosure is defined as one with a negative (positive) residual from Equation (1) or Equation (2). The sum of the frequency of (adjusted) bad-news 2.02, 7.01, and 8.01 items in a quarter, *FREQ_BAD_8K,* is a comprehensive measure of bad-news 8-K disclosure.

Measure of Negative Private Information Based on Short Interest

As noted earlier, a key challenge for the prior literature has been to identify instances where managers possess bad-news information not yet reflected in stock prices. In this section, we propose a novel proxy for managers' negative private information extracted from short interest data. We begin by converting the raw short interest into the short interest ratio, *SI,* by dividing the raw short interest by the total shares outstanding from CRSP. We then estimate the following regression model and obtain its residuals, which we denote as *ResSI,* to capture the negative private information:

$$SI_{i,t} = \alpha + \beta_1 IO_{i,t} + \beta_2 CONVERT_{i,t} + \beta_3 TREND_t + \varepsilon_{i,t} \quad (3)$$

where *i* and *t* represent firm and quarter, respectively. *SI* is raw short interest available at the end of quarter *t* scaled by shares outstanding. Short interest is an outcome resulting from the intersections of shorting demand, supply of loanable shares, and borrowing costs (Beneish, Lee, and Nichols 2015; Reed 2015). In using short interest as a proxy for the negative private information that managers possess, we are interested in the shorting demand arising from bets on the stock price decline, because bad news is yet to be incorporated in the stock price. Therefore, it is important that we purge from raw short interest the effects of the supply of loanable shares and other factors that are not necessarily driven by the shorting demand. We include institutional ownership (*IO*) as a regressor in Equation (3) because institutional ownership is commonly used in the literature as a proxy for the supply of loanable shares (D'Avolio 2002; Nagel 2005). Furthermore, Asquith, Pathak, and Ritter (2005) argue that reported short interest in the United States, which aggregates both valuation and arbitrage shorts, is a noisy proxy for negative private information, especially in recent years, due to institutions' increasing use of various "market neutral" investment strategies. We follow Savor and Gamboa-Cavazos (2011) and use the presence of convertible securities to proxy for arbitrage or hedging-based short selling.[9] We create an indicator variable, *CONVERT,* that takes the value of 1 when a firm has convertible bonds or convertible preferred stocks outstanding, and include it as a regressor to control for the hedging-based shorting that is unrelated to negative private information. Last, short selling has increased over time in the U.S. stock market (Boehmer et al. 2010; Hanson and Sunderam 2014). This upward time trend is attributed to many market-wide institutional

[8] Alternatively, we measure abnormal returns around the three-day disclosure window using the firm-level raw return minus the short interest decile portfolio return on the corresponding day. This is another way to parse out the effect of short interest on firm-specific returns not attributable to the 8-K disclosure. We classify items 7.01 and 8.01 as bad- or good-news disclosure based on the signs of short interest decile-adjusted returns. We further adjust for the effect of earning surprises by regressing the short interest decile-adjusted returns on the earnings surprise to obtain the residual for item 2.02. We find that using this alternative approach to classify bad-news voluntary 8-K disclosures generates qualitatively similar results as those tabulated.

[9] Convertible security arbitrage usually involves buying a convertible security whose imbedded call option appears undervalued and shorting the underlying stock to hedge against the risk associated with stock price movements.

TABLE 1

Descriptive Statistics for Validation Sample

Variable	Mean	Std. Dev.	Q1	Median	Q3
ResSI	−0.001	0.041	−0.025	−0.007	0.009
$ABRET_{t+1}$	0.015	0.241	−0.115	−0.004	0.121
$ABRET_{t+2-t+4}$	0.027	0.412	−0.206	−0.017	0.195
OPP_NETBUY	−0.035	0.148	0.000	0.000	0.000
REPURCHASE	0.026	0.159	0.000	0.000	0.000
SIZE	5.868	1.951	4.417	5.772	7.158
BTM	0.672	0.539	0.325	0.538	0.836
L12_ABRET	0.101	0.555	−0.227	0.000	0.298
L1_ABRET	0.028	0.252	−0.112	0.002	0.131
L2_ABRET	0.029	0.253	−0.112	0.003	0.133
RETVOL	0.131	0.094	0.067	0.105	0.165
ROA	−0.005	0.053	−0.004	0.004	0.017
NUM_AN	5.290	6.080	0.000	3.000	8.000
ISSUE	0.095	0.293	0.000	0.000	0.000
LOSS	0.467	0.499	0.000	0.000	1.000
CAPX	0.010	0.015	0.001	0.005	0.013
IO	0.506	0.313	0.220	0.520	0.773
LEV	0.182	0.178	0.016	0.139	0.292
TURNOVER	0.005	0.005	0.001	0.003	0.006
BAD_MG	0.385	0.487	0.000	0.000	1.000
BAD_8K	0.450	0.498	0.000	0.000	1.000

This table reports the descriptive statistics for residual short interest and other variables for the validation sample, except for *BAD_MG* and *BAD_8K,* which are based on the management guidance sample and 8-K disclosure sample, respectively. The validation sample includes 152,614 firm-quarter observations from 2001 to 2010. The management guidance sample includes 49,393 firm-quarter observations from 2001 to 2010. The 8-K disclosure sample includes 90,265 firm-quarter observations from 2004Q4 to 2010Q4.
All variables are defined in Appendix B.

factors, such as a reduction of average shorting costs, an increase in the supply of loanable shares, and an increasing prevalence of hedge funds. Because these factors do not directly relate to the existence of negative private information about an individual firm, we also include a time-trend variable (*TREND*) as a regressor in Equation (3). Variable definitions are summarized in Appendix B.

We estimate Equation (3) using 163,211 firm-quarter observations (Step 4 in Appendix A). Appendix C reports the results. Consistent with prior literature (D'Avolio 2002; Asquith et al. 2005; Hanson and Sunderam 2014), short interest is positively associated with the supply of loanable shares (as proxied by *IO*), the presence of convertible securities, and the time trend. All three effects are highly statistically significant. The residual of the regression (*ResSI*), which is our measure of negative private information, has a mean of zero, by construction, and a standard deviation of 0.046. The 25th and 75th percentiles equal −0.025 and 0.009, respectively.

Validation of Residual Short Interest as a Proxy for Managers' Negative Private Information

Before turning to our main analysis, we conduct a series of tests to validate residual short interest as a reasonable proxy for the presence and extent of managers' private bad news. We first show that a high level of residual short interest is a strong predictor of negative future stock returns, indicating that residual short interest contains negative information that is yet to be reflected in the stock price. We also document that for the subset of firms that issue bad-news disclosure, the extent to which residual short interest can predict returns over subsequent quarters is largely mitigated, suggesting that the information that managers disclose through bad-news guidance and voluntary 8-Ks overlaps with short sellers' information set. In the second set of analyses, we show that residual short interest correlates with two managerial actions, namely, insider trading and stock repurchases, again suggesting a significant overlap between the private information of managers and that of short sellers.

We conduct our validation analyses using 152,614 firm-quarter observations that we obtain in Step 5 of Appendix A. Table 1 presents the descriptive statistics for residual short interest and other variables that we employ in the validation analyses. To mitigate the influence of extreme values, we winsorize all continuous variables at the 1st and 99th percentiles of their

distributions in the sample. Residual short interest (*ResSI*) has a mean of −0.001, which is, by design, close to zero.[10] Descriptive statistics of other variables are comparable to those reported in prior studies (e.g., Bergman and Roychowdhury 2008; Cooper et al. 2018).

Future Abnormal Stock Returns

We regress future stock returns on residual short interest to examine whether the negative information reflected in residual short interest is private (i.e., not yet reflected in the stock price). If the negative news captured by residual short interest is already public, then the current stock price would reflect this information and residual short interest would not predict future returns. Table 2, Panel A reports the results. The dependent variable is cumulative market-adjusted returns (*ABRET*), and we control for book-to-market ratio, size, and momentum effects, factors that are known to be associated with stock returns. In Columns (1) and (2), we explore the association between *ResSI* and stock returns during quarter t+1 and over quarters t+2 to t+4, respectively, based on the validation sample. The results show that residual short interest is negatively associated with future abnormal stock returns, implying that the negative news captured by residual short interest is *not* made public; instead, investors are informed gradually over subsequent quarters. This finding mirrors the evidence in prior studies showing that raw short interest predicts future stock returns over periods extending to one year (Asquith and Meulbroek 1995; Desai et al. 2002).

We next examine the effect of bad-news disclosure on the relation between residual short interest and future stock returns, based on either the management guidance sample or the 8-K disclosure sample. We create an indicator variable, *BAD_MG* (*BAD_8K*), which equals 1 if managers issue at least one bad-news guidance (bad-news voluntary 8-K) during quarter t+1, and 0 otherwise. The mean value of *BAD_MG* or *BAD_8K* is 0.385 (0.450) in the management guidance (8-K disclosure) sample. We include *BAD_MG* or *BAD_8K,* as well as their respective interactions with residual short interest, as additional explanatory variables. The interaction term captures the effect of bad-news disclosure on the return predictability of residual short interest. The results are reported in Columns (3) to (6) of Table 2, Panel A, where the dependent variable is the market-adjusted stock returns over quarter t+1. As expected, the coefficient on the indicator variable (*BAD_MG* or *BAD_8K*) is negative and statistically significant, suggesting that the market reacts negatively to bad-news disclosures. Notably, the coefficient on the interaction term (*ResSI* × *BAD_MG* or *ResSI* × *BAD_8K*) is also negative and statistically significant. The negative coefficient on the interaction term indicates that residual short interest in quarter t predicts more negative returns in quarter t+1 for firms with bad-news disclosures, because managers' private bad news captured by residual short interest in quarter t is now incorporated in stock prices when managers disclose bad news in quarter t+1.

Columns (7) to (10) of Table 2, Panel A present the regression results for the relation between residual short interest and future stock returns for quarters t+2 through t+4, a period after the announcement of bad-news disclosure in quarter t+1. In Column (8), the coefficient estimate on *BAD_MG* is insignificantly different from zero, as is the coefficient estimate on *BAD_8K* in Column (10). More importantly, the coefficient estimate on the interaction term, *ResSI* × *BAD_MG* (*ResSI* × *BAD_8K*), is significantly positive, which suggests that bad news disclosed through management guidance (voluntary 8-Ks) weakens the extent to which residual short interest can predict future returns over quarters t+2 to t+4. For the analysis based on bad-news guidance, the sum of the coefficient estimates on *ResSI* and *ResSI* × *BAD_MG* (−0.003, F-statistic = 0.00) is statistically indistinguishable from zero, suggesting that when managers disclose bad news through earnings guidance, residual short interest loses its predictive power for subsequent stock returns over quarters t+2 to t+4. For the analysis based on bad-news 8-Ks, the sum of the coefficients on *ResSI* and *ResSI* × *BAD_8K* (−0.133, F-statistic = 3.68) is still significantly negative, but the magnitude is much smaller than that of the coefficient on *ResSI*. This evidence suggests that the information managers disclose through management guidance or voluntary 8-Ks overlaps significantly with that of short sellers. Our results are robust to firm fixed effect models, which we use to address potential concerns about correlated omitted variables influencing the results (untabulated for brevity).

Insider Trading and Stock Repurchases

We next turn to two managerial actions, namely, insider trading and stock repurchases, which are not as frequently observed as short interest, but can reveal managers' private information. If residual short interest captures managers' negative private information, then we expect it to be associated with these actions. The tests in this section, again, are conducted on the validation sample.

Prior literature suggests that possession of private information motivates managers to trade their own firm's stock (see, for example, Cheng and Lo 2006). While earlier studies use raw values of insider trading, a more recent paper by Cohen et al.

[10] The mean is not exactly zero because not all observations used in estimating Equation (3) are included in the validation sample, as we exclude observations with missing control variables.

TABLE 2

Validation Tests of Residual Short Interest

Panel A: Relation between Residual Short Interest and Future Abnormal Stock Returns

	Dependent Variable = *ABRET*									
	t+1	*t*+2 to *t*+4	*t*+1				*t*+2 to *t*+4			
	Validation Sample		Management Guidance Sample		8-K Disclosure Sample		Management Guidance Sample		8-K Disclosure Sample	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ResSI	−0.142***	−0.301***	−0.093***	−0.073**	−0.107***	−0.056**	−0.160**	−0.256***	−0.234***	−0.316***
	(−7.64)	(−6.26)	(−3.50)	(−2.14)	(−5.27)	(−2.25)	(−2.43)	(−3.46)	(−4.36)	(−5.15)
BAD_MG				−0.054***				0.001		
				(−27.17)				(0.20)		
ResSI × *BAD_MG*				−0.086*				0.253***		
				(−1.77)				(2.60)		
BAD_8K						−0.062***				0.002
						(−45.63)				(0.66)
ResSI × *BAD_8K*						−0.219***				0.183**
						(−6.54)				(2.49)
SIZE	0.005***	0.004***	−0.004***	−0.002***	0.009***	0.011***	−0.011***	−0.011***	0.011***	0.011***
	(13.86)	(3.45)	(−4.75)	(−2.63)	(19.13)	(24.83)	(−5.81)	(−5.71)	(8.96)	(8.97)
BTM	0.042***	0.065***	0.047***	0.043***	0.017***	0.012***	0.064***	0.064***	0.022***	0.022***
	(21.32)	(13.22)	(10.26)	(9.48)	(6.88)	(5.26)	(5.87)	(5.91)	(3.39)	(3.38)
L12_ABRET	0.006***	0.008**	−0.006**	−0.007***	−0.005**	−0.004**	−0.011*	−0.011*	−0.018***	−0.018***
	(4.48)	(2.53)	(−2.02)	(−2.63)	(−2.55)	(−2.23)	(−1.82)	(−1.84)	(−3.88)	(−3.90)
Constant	0.058***	0.006	0.163***	0.168***	−0.048***	−0.021	0.237***	0.235***	−0.190***	−0.190***
	(3.43)	(0.16)	(14.73)	(15.17)	(−2.70)	(−0.97)	(10.84)	(10.72)	(−3.59)	(−3.58)
Observations	152,614	152,614	49,393	49,393	90,265	90,265	49,393	49,393	90,265	90,265
Adjusted R^2	0.049	0.048	0.058	0.072	0.043	0.074	0.060	0.060	0.046	0.046
Calendar Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ResSI + *ResSI* × *BAD_MG* or *ResSI* + *ResSI* × *BAD_8K* (F-statistics)								−0.003 (0.00)		−0.133* (3.68)

(continued on next page)

TABLE 2 (continued)

Panel B: Relation between Residual Short Interest and Insider Trading

	Dependent Variable = *OPP_NETBUY$_t$*
ResSI	−0.019**
	(−2.28)
L1_ABRET	−0.011***
	(−14.28)
L2_ABRET	−0.015***
	(−20.68)
RETVOL	0.025***
	(8.81)
SIZE	0.000
	(0.58)
ROA	−0.035***
	(−8.77)
BTM	0.008***
	(15.63)
NUM_AN	0.000
	(1.06)
ISSUE	0.002**
	(2.36)
LOSS	0.007***
	(13.44)
CAPX	−0.078***
	(−3.08)
IO	−0.024***
	(−16.48)
LEV	0.017***
	(9.34)
TURNOVER	−0.921***
	(−10.28)
Constant	−0.011***
	(−2.80)
Observations	152,614
Adjusted R^2	0.077
Calendar Quarter FE	Yes
Industry FE	Yes

(continued on next page)

TABLE 2 (continued)

Panel C: Relation between Residual Short Interest and Repurchase Announcement

	Dependent Variable = Prob (*REPURCHASE*$_{t+1}$)
ResSI	−1.168**
	(−2.06)
L1_ABRET	−1.173***
	(−10.21)
L2_ABRET	−0.174*
	(−1.66)
RETVOL	−3.910***
	(−8.57)
SIZE	0.140***
	(6.06)
ROA	6.692***
	(6.90)
BTM	−0.008
	(−0.14)
NUM_AN	0.005
	(0.85)
ISSUE	−0.493***
	(−3.23)
LOSS	−0.662***
	(−10.76)
CAPX	−11.343***
	(−5.44)
IO	0.765***
	(7.18)
LEV	−1.280***
	(−7.68)
Constant	−4.717***
	(−5.03)
Observations	152,614
Pseudo R^2	0.107
Calendar Quarter FE	Yes
Industry FE	Yes

***, **, * Indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
This table reports the validation test results of residual short interest as a proxy for managers' negative private information. Panel A reports the OLS regression results for the relation between residual short interest in quarter t and future abnormal stock returns during quarter t+1, and over quarters t+2 to t+4, respectively; Panel B reports the OLS regression result for the relation between residual short interest in quarter t and opportunistic net insider buying in quarter t; and Panel C reports the logistic regression result for the relation between residual short interest in quarter t and the incidence of a repurchase announcement in quarter t+1. The t-statistics (z-statistics) are reported in parentheses for OLS (logistic) regressions. Standard errors are clustered by firm.
All variables are defined in Appendix B.

(2012) proposes a framework to isolate insiders' *opportunistic* trading from their *routine* trading and argues that opportunistic insider buying (selling) is a better proxy for managers' positive (negative) private information. We, therefore, follow Cohen et al.'s (2012) methodology and focus on opportunistic insider trading. We obtain insider trading data from the Thomson-Reuters Insider Filings database, which records transactions by corporate insiders and blockholders. We focus on the top officers of the firm, including the CEO, CFO, COO, president, and board chairman, because top officers have greater influence on and more discretion in the disclosure policy than other insiders, such as directors and blockholders. We calculate a quarterly measure of opportunistic net buying (*OPP_NETBUY*) based on the top officers' aggregated opportunistic buys minus top officers' aggregated opportunistic sells during the quarter.

We regress opportunistic net buying on residual short interest and a set of control variables. The control variables include firm-specific factors that we introduce and employ later in our analyses of the relation between residual short interest and disclosure practice. In addition, we follow prior literature (e.g., Massa et al. 2015) and include two additional control variables, leverage (*LEV*) and stock turnover (*TURNOVER*), that have been found to be associated with insider trading. As shown in Table 2, Panel B, residual short interest is negatively associated with opportunistic net insider buying in the concurrent quarter *t*. That is, managers' opportunistic buying (selling) decreases (increases) in residual short selling, indicating an overlap between the information set of managers and that of short sellers. This finding is consistent with that in Khan and Lu (2013) and Massa et al. (2015). The results are robust to a model where industry fixed effects are replaced with firm fixed effects (untabulated), mitigating the concern that time-invariant, firm-specific factors omitted from the model may explain the results.

Stock repurchase is the second managerial action from which we infer managers' private information. Prior studies argue that an important motivation for the repurchase decision is the managerial belief that the stock is undervalued (D'Mello and Shroff 2000), which is equivalent to saying that managers possess positive information about the firm that is not shared by outside investors. To test whether residual short interest is negatively associated with the announcement of an open market repurchase in the next quarter, we obtain open market repurchase announcements from Securities Data Company (SDC) Platinum. We focus on the announcements of repurchase programs, rather than actual repurchases, because the former action can be taken quickly in response to market conditions and information arrivals, while the latter typically reflects the execution of a previously announced repurchase program. We allow some time (i.e., one quarter) for managers to announce the repurchases, because such decisions require boards' approval. If residual short interest reflects negative private information that managers hold, then stock repurchases should be less likely when residual short interest is high.

We regress the decision to repurchase stock on residual short interest and the controls. As in our analyses of opportunistic net buying, the controls include firm-level factors that we employ in our analyses of the relation between residual short interest and disclosure practice. We also control for leverage, which is known to be an important determinant of stock repurchase decisions (Hribar, Jenkins, and Johnson 2006; Brockman, Howe, and Mortal 2008). The result in Table 2, Panel C confirms that residual short interest is indeed negatively associated with the likelihood of open market repurchases.[11] Overall, the results in this section provide multiple pieces of evidence that support the argument that residual short interest is a reasonable proxy for managers' negative private information.

IV. RESIDUAL SHORT INTEREST AND BAD-NEWS DISCLOSURE

Research Design

To test whether firms with high residual short interest disclose bad news more or less frequently, we estimate the following ordinary least squares (OLS) model:

$$FREQ\_BAD\_NEWS_{i,t+1} = \alpha + \beta ResSI_{i,t} + c' Controls_{i,t} + Industry\ Fixed\ Effects + Calendar\ Quarter\ Fixed\ Effects + \varepsilon_{i,t+1} \quad (4)$$

The subscripts *i* and *t* denote the firm and quarter, respectively. The dependent variable *FREQ_BAD_NEWS* is alternately the frequency of bad news management guidance (*FREQ_BAD_MG*) or the frequency of bad-news voluntary 8-K disclosure (*FREQ_BAD_8K*) during calendar quarter *t*+1. We examine its association with the residual short interest (*ResSI*) at the end of calendar quarter *t*, as computed from Equation (3). We expect the coefficient on *ResSI* to be positive (negative) if managers have a general tendency to release (withhold) bad news. Our choice of calendar quarter as the window of time to measure disclosure frequency follows that of prior studies (e.g., Kim et al. 2017; Cooper et al. 2018). As earnings information is released every quarter, making it harder for managers to withhold bad news beyond one quarter, aggregating disclosure frequency by quarter makes economic sense (Bergman and Roychowdhury 2008).

[11] Stock repurchase is not a frequent event and, therefore, we do not have enough variation within each firm to estimate the model with firm fixed effects.

Following Bergman and Roychowdhury (2008) and Cooper et al. (2018), we control for several firm-specific factors that are known determinants of disclosure and short selling. We control for stock returns in the past two quarters (*L1_ABRET, L2_ABRET*) because both short selling and disclosure decisions are likely to be influenced by recent stock performance. We control for return volatility over the past six months (*RETVOL*) because firm-specific risk can influence short selling, and riskier firms are less likely to disclose (Waymire 1984). We control for firm size (*SIZE*) and book-to-market ratio (*BTM*) because these firm characteristics are shown to be related to disclosure proxies (Cooper et al. 2018), and the amount of news varies across firms depending on their size and growth opportunities. Because poor firm performance is potentially correlated with both high short interest and bad-news disclosure, we control for return on assets (*ROA*) and loss incidence (*LOSS*). Lang and Lundholm (1996) and Ajinkya, Bhojraj, and Sengupta (2005) find a positive relation between analyst following and disclosure. Bushee and Noe (2000) document a relation between institutional ownership and corporate disclosure practice. Analyst coverage and institutional ownership influence a firm's information environment and short selling opportunities. Thus, we control for analyst coverage (*NUM_AN*) and institutional ownership (*IO*). New equity issues and large capital expenditure affect managerial disclosure incentives (Bergman and Roychowdhury 2008; Cooper et al. 2018). These events also provide short selling opportunities. Thus, we include in the regression an indicator for new equity issues (*ISSUE*) and capital expenditure (*CAPX*). In addition, following Cooper et al. (2018), when the dependent variable is 8-K disclosure, we include the frequency of mandatory items in 8-Ks filed in quarter t+1 (*FREQ_MAN_8K*) to control for the mandatory information disclosed during the same quarter. Finally, we include calendar quarter fixed effects and industry fixed effects.[12] We estimate Equation (4) using OLS by pooling all firm-quarter observations and cluster standard errors by firms.

The theoretical arguments for disclosure incentives suggest that variation in residual short interest across firms relates to bad-news disclosure. Therefore, we use a pooled cross-sectional analysis to establish our baseline result. To control for time-invariant omitted variables that may lead to a spurious cross-sectional relation between residual short interest and managerial disclosure, we also estimate an alternate version of Equation (4) that includes firm fixed effects instead of industry fixed effects. If the relation between residual short interest and bad-news disclosure is driven by unobservable time-invariant differences across firms, the relation will be insignificant in the firm fixed effect model.

Descriptive Statistics

Table 3, Panel A presents the descriptive statistics of voluntary disclosure, short interest, and control variables in Equation (4) for the two test samples: the management guidance sample and the 8-K disclosure sample, respectively. The firms in our management guidance sample issue an average of 0.813 management guidance each quarter (untabulated), of which about one-half (0.440/0.813) are bad-news guidance and one-third (0.298/0.813) are good-news guidance (untabulated), with the rest being guidance that confirms the consensus analyst forecast, consistent with prior literature indicating that management guidance is more likely to disclose bad news (Bergman and Roychowdhury 2008; Seybert and Yang 2012). When it comes to 8-K disclosure, firms in the 8-K disclosure sample file an average of 4.148 mandatory 8-K items and 1.123 voluntary 8-K items (untabulated), of which about one half (0.569/1.123) are bad-news disclosures, while the rest are good-news disclosures.[13] The mean and median of *FREQ_MAN_8K* are higher than those in Cooper et al. (2018), because firms file more 8-K items after 2004 (Lerman and Livnat 2010; McMullin, Miller, and Twedt 2018); by contrast, the mean and median of frequency of voluntary 8-K disclosures are lower than those in Cooper et al. (2018), because we exclude voluntary 8-K items that overlap with mandatory 8-K items and periodic reports (10-Ks and 10-Qs) to properly identify bad- and good-news voluntary 8-Ks, respectively.

Table 3, Panel B shows the Pearson correlation matrix for the frequency of bad-news guidance, the frequency of bad-news voluntary 8-K items, residual short interest, and the control variables. We find that the two voluntary bad-news disclosure measures, *FREQ_BAD_MG* and *FREQ_BAD_8K,* are positively correlated with each other, with a correlation coefficient of 0.10, suggesting that while the two disclosure measures overlap, 8-K disclosures include more than just management earnings guidance. More importantly, *FREQ_BAD_MG* and *FREQ_BAD_8K* in quarter t+1 are significantly and negatively correlated with residual short interest (*ResSI*) in quarter t, providing preliminary evidence that managers, in general, withhold bad news. The magnitude of the correlations between the explanatory variables is not large, suggesting that multicollinearity is not a substantial concern.

[12] Management guidance is often bundled with an earnings announcement. In a robustness check, we create a control variable for the frequency of management guidance issued in conjunction with earnings announcements and include it as an additional explanatory variable in Equation (4). The results (untabulated) with this additional control are similar to those tabulated.

[13] Because our dependent variable is a count variable, we also estimate Equation (4) using a Poisson regression. In addition, we estimate the logistic regression with an indicator of disclosing at least one bad-news guidance (8-Ks) in quarter t+1 as a dependent variable. The untabulated results are qualitatively similar to those in Table 4.

TABLE 3

Descriptive Statistics for Management Guidance Sample and 8-K Disclosure Sample

Panel A: Descriptive Statistics for Voluntary Disclosure Measures, Residual Short Interest, and Control Variables

Variable	Mean	Std. Dev.	Q1	Median	Q3
Descriptive Statistics for the Management Guidance Sample (n = 49,393)					
FREQ_BAD_MG	0.440	0.613	0.000	0.000	1.000
ResSI	−0.004	0.047	−0.033	−0.015	0.009
L1_ABRET	0.024	0.216	−0.098	0.007	0.121
L2_ABRET	0.026	0.219	−0.098	0.008	0.123
RETVOL	0.117	0.077	0.064	0.097	0.145
SIZE	7.004	1.667	5.856	6.896	8.054
ROA	0.008	0.031	0.003	0.011	0.022
BTM	0.552	0.393	0.294	0.463	0.698
NUM_AN	8.510	6.370	4.000	7.000	12.000
ISSUE	0.076	0.266	0.000	0.000	0.000
LOSS	0.360	0.480	0.000	0.000	1.000
CAPX	0.011	0.011	0.003	0.007	0.014
IO	0.698	0.238	0.548	0.734	0.871
Descriptive Statistics for the 8-K Disclosure Sample (n = 90,265)					
FREQ_BAD_8K	0.569	0.732	0.000	0.000	1.000
ResSI	−0.001	0.044	−0.028	−0.010	0.011
L1_ABRET	0.006	0.227	−0.120	−0.013	0.100
L2_ABRET	0.007	0.226	−0.117	−0.012	0.101
RETVOL	0.119	0.083	0.064	0.099	0.151
SIZE	6.088	1.908	4.697	5.991	7.343
ROA	−0.002	0.051	−0.002	0.006	0.018
BTM	0.649	0.518	0.318	0.524	0.804
NUM_AN	5.901	6.256	1.000	4.000	9.000
ISSUE	0.086	0.281	0.000	0.000	0.000
LOSS	0.440	0.496	0.000	0.000	1.000
CAPX	0.010	0.015	0.001	0.005	0.012
IO	0.564	0.314	0.293	0.604	0.827
FREQ_MAN_8K	4.148	3.313	2.000	3.000	6.000

(continued on next page)

Main Results

Table 4 reports the results from the OLS estimation of the frequency of bad-news management guidance (*FREQ_BAD_MG*) in Columns (1) and (2) and the frequency of bad-news 8-K disclosure (*FREQ_BAD_8K*) in Columns (3) and (4), each measured in quarter t+1, as a function of the level of residual short interest in quarter t, as specified in Equation (4). The results from the pooled regression are presented in Columns (1) and (3). The coefficients on residual short interest (*ResSI*) are −0.315 and −0.125, respectively, and significantly negative (t-statistics = −3.65 and −2.18, respectively). A one-standard-deviation increase in *ResSI* results in about 0.0148 (−0.315 × 0.047) fewer instances of bad-news management guidance over the next quarter, *ceteris paribus*. The decrease in bad-news management guidance represents 3.3 percent of the sample mean (0.440, see Table 3), which is economically meaningful and not too large to be implausible. Similarly, a one-standard-deviation increase in *ResSI* results in about 0.005 (−0.125 × 0.044) fewer bad-news 8-Ks over the next quarter, *ceteris paribus*.[14]

Columns (2) and (4) of Table 4 present the results of the firm fixed effect model. The coefficients on *ResSI* remain significantly negative (t-statistics = −2.97 and −2.01, respectively), suggesting that our results are not driven by time-invariant

[14] The effect of residual short interest on disclosure is comparable to that of key disclosure determinants identified in prior studies (e.g., Waymire 1984; Kothari et al. 2009). For example, a one-standard-deviation increase in *RETVOL* is associated with a decrease of 0.019 (−0.255 × 0.077) in *FREQ_BAD_MG* and a decrease of 0.007 (−0.092 × 0.083) in *FREQ_BAD_8K*, respectively; a one-standard-deviation increase in *ROA* is associated with a decrease of 0.003 (−0.103 × 0.031) in *FREQ_BAD_MG* and a decrease of 0.008 (−0.162 × 0.051) in *FREQ_BAD_8K*, respectively. Thus, the effect of residual short interest is similar to that of risk (*RETVOL*) and financial performance (*ROA*) on management guidance and 8-K disclosure.

TABLE 3 (continued)

Panel B: Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) *FREQ_BAD_MG*														
(2) *FREQ_BAD_8K*	**0.10**													
(3) *FREQ_MAN_8K*	**0.01**	**0.12**												
(4) *ResSI*	**−0.04**	**−0.01**	**0.04**											
(5) *L1_ABRET*	**−0.05**	**0.01**	**−0.01**	**−0.03**										
(6) *L2_ABRET*	**−0.01**	0.00	**−0.02**	**−0.03**	**−0.02**									
(7) *RETVOL*	**−0.12**	**−0.03**	**0.03**	**0.18**	**0.21**	**0.14**								
(8) *SIZE*	**0.17**	**0.09**	**0.17**	**−0.09**	**0.02**	**0.03**	**−0.27**							
(9) *ROA*	**0.08**	0.00	**−0.08**	**−0.12**	**0.07**	**0.09**	**−0.30**	**0.26**						
(10) *BTM*	**−0.10**	**−0.02**	**−0.03**	**−0.04**	**−0.14**	**−0.13**	**0.13**	**−0.40**	**−0.04**					
(11) *NUM_AN*	**0.12**	**0.07**	**0.16**	**−0.02**	**−0.05**	**−0.04**	**−0.12**	**0.77**	**0.15**	**−0.24**				
(12) *ISSUE*	**−0.04**	0.00	**0.16**	**0.08**	**0.08**	**0.05**	**0.13**	**−0.05**	**−0.13**	**−0.06**	**−0.04**			
(13) *LOSS*	**−0.10**	**−0.02**	**0.08**	**0.09**	**−0.02**	**−0.05**	**0.36**	**−0.31**	**−0.44**	**0.22**	**−0.17**	**0.08**		
(14) *CAPX*	**0.06**	**0.03**	**0.08**	**0.06**	**−0.01**	**0.01**	**0.03**	**0.11**	**0.05**	**−0.13**	**0.14**	**0.03**	**−0.03**	
(15) *IO*	**0.13**	**0.04**	**0.15**	**−0.02**	**−0.04**	**−0.01**	**−0.14**	**0.65**	**0.21**	**−0.20**	**0.55**	**−0.05**	**−0.14**	**0.13**

This table reports the descriptive statistics for and Pearson correlation among the main variables. Panel A reports the descriptive statistics for measures of voluntary disclosure, residual short interest, and control variables for the management guidance sample and 8-K disclosure sample, respectively; Panel B reports Pearson correlations among the main variables. The correlations in Column (1), except the correlation between *FREQ_BAD_MG* with *FREQ_BAD_8K* and *FREQ_MAN_8K*, are based on the management guidance sample; the correlations in Columns (2) and (3) are based on the 8-K disclosure sample; the correlation between *FREQ_BAD_MG* with *FREQ_BAD_8K* and *FREQ_MAN_8K* are based on the overlap of the management guidance sample and 8-K disclosure sample; and the correlations in the remaining columns are based on the validation sample. The validation sample includes 152,614 firm-quarter observations from 2001 to 2010. The management guidance sample and the 8-K disclosure sample include 49,393 firm-quarter observations from 2001 to 2010 and 90,265 firm-quarter observations from 2004Q4 to 2010Q4, respectively, with an overlap of 29,660 firm-quarter observations. A correlation coefficient in bold indicates statistical significance at the 5 percent level or lower.
All variables are defined in Appendix B.

omitted variables. The results in Table 4 suggest that following higher residual short interest, a proxy of negative private information, managers are less likely to disclose the negative information they possess, supporting the argument that managers, in general, withhold bad news.[15]

We also check the robustness of our results after removing cases where measurement errors in residual short interest are potentially high. We identify two cases where managers' information gleaned from their other actions (insider trading and repurchase announcements) may diverge from the information revealed by residual short interest. First, we remove those firm-quarter observations where (1) managers engage in net buying (i.e., opportunistic net buying is greater than zero), but short sellers take large positions in the stock (i.e., residual short interest falls in the top tercile of its distribution); and (2) managers engage in net selling (i.e., opportunistic net buying is less than zero), but short sellers are not paying attention to the stock (i.e., residual short interest falls in the bottom tercile). When we estimate Equation (4) using the remaining observations, we continue to find that residual short interest is negatively associated with bad-news disclosure, measured by both bad-news guidance and bad-news 8-Ks (untabulated for brevity). Second, we exclude firm-quarters where managers announce a repurchase program (indicating their positive information), while residual short interest falls in the top tercile (indicating the presence of short sellers' negative information). In these situations, managers hold positive beliefs, but short sellers have bearish views. The (untabulated) results show that residual short interest continues to be negatively associated with bad-news disclosure, measured by both bad-news guidance and bad-news 8-Ks. Thus, the results are robust to restricted samples, where the measurement error in residual short interest is likely to be minimal.

To mitigate the concern that the relation between residual short interest and bad-news disclosure we document in Table 4 is driven by firms' overall disclosure policy rather than by the managerial tendency to withhold bad news, we conduct a placebo test. We replace the dependent variable of bad-news disclosure in Equation (4) with good-news disclosure. The results reported in Table 5 show that there is no association between residual short interest and good-news voluntary disclosure, as the coefficients on *ResSI* for both the guidance and 8-K regressions are insignificant, irrespective of whether industry or firm fixed

[15] The management guidance test is robust to (1) estimating Equation (4) separately for firms that provide management guidance in three out of the four prior quarters ("regular" forecasters) and the rest ("sporadic" forecasters); and (2) estimating Equation (4) for a less restrictive sample that requires at least one instance of management guidance in the entire sample period.

TABLE 4

Relation between Residual Short Interest and Voluntary Bad-News Disclosure

	Dependent Variable = *FREQ_BAD_MG* Management Guidance Sample		Dependent Variable = *FREQ_BAD_8K* 8-K Disclosure Sample	
	(1)	(2)	(3)	(4)
ResSI	−0.315***	−0.311***	−0.125**	−0.147**
	(−3.65)	(−2.97)	(−2.18)	(−2.01)
L1_ABRET	−0.126***	−0.142***	0.014	−0.001
	(−10.40)	(−11.87)	(1.54)	(−0.11)
L2_ABRET	−0.042***	−0.057***	0.018**	−0.003
	(−3.70)	(−5.19)	(2.09)	(−0.38)
RETVOL	−0.255***	−0.219***	−0.092***	−0.013
	(−5.32)	(−4.49)	(−2.95)	(−0.40)
SIZE	0.032***	0.112***	0.021***	0.109***
	(6.90)	(10.68)	(7.28)	(14.31)
ROA	−0.103	0.012	−0.162***	−0.337***
	(−0.98)	(0.12)	(−3.21)	(−5.51)
BTM	−0.058***	−0.018	0.006	0.020**
	(−5.39)	(−1.19)	(1.05)	(2.35)
NUM_AN	−0.001	0.003**	0.002**	0.002
	(−0.55)	(2.52)	(2.23)	(1.38)
ISSUE	0.001	0.006	0.034***	0.037***
	(0.08)	(0.40)	(2.71)	(2.90)
LOSS	−0.051***	−0.067***	0.010*	0.012*
	(−6.10)	(−8.50)	(1.82)	(1.87)
CAPX	1.288***	1.456***	0.017	0.103
	(3.29)	(3.95)	(0.09)	(0.45)
IO	0.114***	−0.006	−0.002	−0.048*
	(6.11)	(−0.19)	(−0.14)	(−1.82)
FREQ_MAN_8K			0.020***	0.013***
			(22.69)	(15.87)
Constant	0.091**	−0.345***	0.462***	−0.269***
	(2.34)	(−4.72)	(4.10)	(−5.79)
Observations	49,393	49,393	90,265	90,265
Adjusted R^2	0.067	0.149	0.041	0.104
Calendar Quarter FE	Yes	Yes	Yes	Yes
Industry FE	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes

***, **, * Indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
This table reports the regression results from estimating Equation (4) for the relation between residual short interest and voluntary bad-news disclosure. The OLS regression results of the frequency of bad-news management guidance (*FREQ_BAD_MG*) are presented in Columns (1) and (2); the results of the frequency of bad-news 8-K disclosure (*FREQ_BAD_8K*) are presented in Columns (3) and (4). The t-statistics are reported in parentheses and are based on standard errors that are clustered by firm.
Variables are defined in Appendix B.

effects are included. Thus, the results in Table 5 suggest that the negative association between residual short interest and bad-news disclosure in Table 4 is not simply a manifestation of a general relation between short interest and firms' disclosure policy.

Cross-Sectional Analyses: Litigation Risk and CEO Equity Incentives

So far, our results suggest that the incentive to withhold bad news dominates the incentive to disclose for a typical manager. Because the two competing incentives vary significantly across firms, we expect the relation between residual short interest and disclosure to vary predictably across firms. Evidence of systematic cross-sectional variation in line with the

TABLE 5

Relation between Residual Short Interest and Voluntary Good-News Disclosure

	Dependent Variable = *FREQ_GOOD_MG* Management Guidance Sample		Dependent Variable = *FREQ_GOOD_8K* 8-K Disclosure Sample	
	(1)	(2)	(3)	(4)
ResSI	0.071	−0.066	0.074	0.114
	(0.90)	(−0.64)	(1.03)	(1.35)
L1_ABRET	0.144***	0.117***	0.024**	−0.001
	(12.11)	(9.27)	(2.34)	(−0.11)
L2_ABRET	0.073***	0.047***	0.019*	0.000
	(6.69)	(4.16)	(1.91)	(0.05)
RETVOL	−0.008	−0.014	−0.032	0.013
	(−0.19)	(−0.30)	(−0.85)	(0.33)
SIZE	0.022***	0.003	0.018***	−0.046***
	(5.48)	(0.34)	(4.97)	(−5.53)
ROA	0.873***	0.857***	0.446***	0.559***
	(9.64)	(9.04)	(7.45)	(8.59)
BTM	−0.017*	−0.053***	0.000	−0.029***
	(−1.90)	(−3.78)	(0.01)	(−2.86)
NUM_AN	0.001	−0.001	0.000	−0.004***
	(0.82)	(−0.42)	(0.26)	(−3.18)
ISSUE	0.010	−0.004	0.055***	0.065***
	(0.56)	(−0.26)	(4.05)	(4.88)
LOSS	−0.004	−0.002	−0.019***	−0.007
	(−0.51)	(−0.29)	(−2.79)	(−1.05)
CAPX	−0.191	−0.595*	−0.108	−0.440*
	(−0.59)	(−1.75)	(−0.43)	(−1.72)
IO	0.055***	−0.005	0.058***	0.009
	(3.28)	(−0.16)	(3.82)	(0.33)
FREQ_MAN_8K			0.015***	0.006***
			(15.90)	(6.71)
Constant	−0.038	0.187***	0.556***	0.794***
	(−1.15)	(2.76)	(5.25)	(15.32)
Observations	49,393	49,393	90,265	90,265
Adjusted R^2	0.045	0.100	0.027	0.108
Calendar Quarter FE	Yes	Yes	Yes	Yes
Industry FE	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes

***, **, * Indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
This table reports the regression results for the relation between residual short interest and voluntary good-news disclosure. The OLS regression results of the frequency of good-news management guidance (*FREQ_GOOD_MG*) are presented in Columns (1) and (2); the results of the frequency of good-news 8-K disclosure (*FREQ_GOOD_8K*) are presented in Columns (3) and (4). The t-statistics are reported in parentheses and are based on standard errors that are clustered by firm.
Variables are defined in Appendix B.

predictions from the previous literature would strengthen our inference that our results are underpinned by managerial incentives and not by omitted variables.

We first examine the cross-sectional variation in the relation between residual short interest and disclosure practice conditional on litigation risk. Skinner (1994) and Billings and Cedergren (2015) argue that the asymmetric loss function for managers induced by the U.S. legal system creates incentives for managers to disclose bad news quickly to reduce the probability of being sued and if sued, to reduce settlement costs. Thus, we expect that the negative association between residual short interest and proclivity to disclose bad news documented in Table 4 is mitigated when managers face high expected litigation risk. Using Kim and Skinner's (2012, Table 7, Column (3)) model to estimate the litigation risk an individual firm faces, we calculate the probability of litigation using the coefficient estimates. We then classify our sample into firms with high

TABLE 6

Litigation Risk, Equity Incentive, and the Relation between Residual Short Interest and Voluntary Bad-News Disclosure

Panel A: Subsamples Partitioned by Litigation Risk

	Dependent Variable = *FREQ_BAD_MG* Management Guidance Sample		Dependent Variable = *FREQ_BAD_8K* 8-K Disclosure Sample	
	High Litigation Risk (1)	Low Litigation Risk (2)	High Litigation Risk (3)	Low Litigation Risk (4)
ResSI	−0.202*	−0.486***	0.041	−0.180**
	(−1.94)	(−3.89)	(0.44)	(−2.33)
Constant	−0.241***	0.081	0.170***	0.519***
	(−4.71)	(1.42)	(4.19)	(4.51)
Observations	23,453	23,452	41,175	41,093
Adjusted R^2	0.066	0.069	0.022	0.068
Other Controls	Yes	Yes	Yes	Yes
Calendar Quarter FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Difference in *ResSI*	0.284**		0.221***	
z-statistics	(2.47)		(2.58)	

Panel B: Subsamples Partitioned by CEO Equity Incentive (*DELTA*)

	Dependent Variable = *FREQ_BAD_MG* Management Guidance Sample		Dependent Variable = *FREQ_BAD_8K* 8-K Disclosure Sample	
	High *DELTA* (1)	Low *DELTA* (2)	High *DELTA* (3)	Low *DELTA* (4)
ResSI	−0.698***	−0.160	−0.158**	0.078
	(−4.05)	(−1.16)	(−2.40)	(0.45)
Constant	−0.122	0.205***	0.527***	1.095***
	(−1.05)	(2.80)	(5.37)	(11.73)
Observations	16,365	16,363	19,344	19,465
Adjusted R^2	0.053	0.063	0.049	0.021
Other Controls	Yes	Yes	Yes	Yes
Calendar Quarter FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Difference in *ResSI*	−0.538***		−0.236*	
z-statistics	(−3.45)		(−1.79)	

***, **, * Indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
This table reports the OLS regression results for voluntary bad-news disclosure across subsamples. In Panel A, we divide our sample into high (low) litigation risk groups based on median expected litigation risk. In Panel B, we divide our sample into high (low) managerial equity incentive groups based on median CEO equity delta. The t-statistics are reported in parentheses and are based on standard errors that are clustered by firm. We also report the difference in the coefficient estimates across subsamples with asymptotic z-statistics in the last two rows.
Variables are defined in Appendix B.

(above-median) and low (below-median) expected litigation risk and compare the relation between residual short interest and bad-news disclosure across the two subsamples. The results for the two subsamples are reported in Table 6, Panel A. Columns (1) and (2) report the results with bad-news guidance as the dependent variable, and Columns (3) and (4) report the results with bad-news 8-K disclosure as the dependent variable. For both measures of bad-news disclosure, the negative relation between residual short interest and the frequency of bad-news disclosure is present for firms with low litigation risk; for firms with high litigation risk, the relation is insignificant when the dependent variable is bad-news 8-K and marginally negative when the

dependent variable is bad-news guidance. An asymptotic z-test suggests that the difference in the coefficients on *ResSI* across the high and low litigation risk subsamples is statistically significant for both bad-news disclosure measures. Overall, Table 6, Panel A provides evidence that expected litigation risk mitigates managers' tendency to withhold bad news.

We next examine the effect of managers' personal interests on the tendency to withhold bad news. Kothari et al. (2009) argue that career concerns that derive from explicit contracts, such as compensation and retention, and implicit contracts, such as future directorships and other job prospects, can motivate managers to withhold bad news. We examine whether a higher equity incentive, measured by higher equity delta, provides managers with greater motivation to withhold bad news and, thus, leads to a stronger negative association between residual short interest and the proclivity to disclose bad news. Following Core and Guay (1999, 2002), we compute the CEO's equity delta by the change in the value of a CEO's stock and option holdings when the stock price changes by 1 percent. We compare subsamples with a high equity incentive (above-median) and a low equity incentive (below-median), classified based on the distribution of CEO equity delta. There are fewer observations available for this analysis because the information on equity delta is available only for Standard & Poor's (S&P) 1500 firms. The results in Table 6, Panel B show that residual short interest is significantly and negatively associated with the frequency of bad-news disclosure only when the CEO's equity incentive is high. No such relation is found when the CEO's equity incentive is low. The coefficients on *ResSI* across the high and low equity incentive subsamples are significantly different at the 1 (10) percent level when the dependent variable is bad-news guidance (bad-news 8-K). These results suggest that the tendency to withhold bad news is more pronounced when managers have greater incentives to support stock prices.

To summarize, the results in Table 6 suggest that the tendency to withhold bad news varies predictably in the cross-section, depending on firms' litigation risk and their need to support the stock price.

V. ADDITIONAL ANALYSES

Natural Experiment of Reg SHO

To further strengthen our inference, we examine the change in the relation between bad-news disclosure and residual short interest around Reg SHO. The adoption of Reg SHO introduced an exogenous shock to the ability of short sellers to trade on their private bad news and, in turn, to the amount of bad news captured by short interest. Under Reg SHO, the SEC relaxed short sale constraints for randomly selected stocks (labeled as "pilot" stocks) included in the Russell 3000 Index, but not for the others (labeled as "control" stocks) over the period from May 2005 to July 2007. When short sale constraints are relaxed, it is easier for investors to take short positions and, thus, short interest would be a better proxy for privately held bad news than under the stricter short sale restrictions. If so, then we expect the relation between residual short interest and bad-news disclosure to be stronger for pilot stocks during the Reg SHO period. We define an indicator variable (*TEST*) equal to 1 for the period of the program from 2005Q2 to 2007Q3, and 0 otherwise. We also define another indicator variable (*PILOT*) equal to 1 for the group of pilot stocks, and 0 for the rest of the Russell 3000 stocks. We use a difference-in-differences (DiD) design to test the effect of Reg SHO on the relation between residual short interest and bad-news disclosure. DiD is captured by the coefficient on the three-way interaction term, $ResSI \times PILOT \times TEST$. Since we include calendar quarter fixed effects, we do not include the standalone variable *TEST* in the regression.[16]

Table 7 presents the results for bad-news guidance in Column (1) and bad-news 8-K disclosure in Column (2). The coefficients on the three-way interaction term, $ResSI \times PILOT \times TEST$, are −0.732 and −0.506, respectively, and they are significant at conventional levels (t-statistics = −2.06 and −1.89, respectively). The negative coefficient on the three-way interaction term suggests that compared to control stocks, the negative relation between residual short interest and bad-news disclosure is more pronounced for pilot stocks during the Reg SHO program period. The results in Table 7 suggest that an exogenous decrease in short sale constraints makes residual short interest a better proxy for the privately held bad news, strengthening the negative association between residual short interest and bad-news disclosure.

Option Market-Based Proxy for Negative Private Information

Prior work suggests that options traders could be another group of sophisticated investors whose trading might indicate the existence of negative private information that is not yet reflected in stock prices (Jin, Livnat, and Zhang 2012). Unlike short interest, which is available for the majority of stocks traded on the main exchanges, options are available for only the most liquid and largest stocks. Thus, option market-based measures are less appealing to us. Nevertheless, using data on the

[16] In an alternative specification, we include firm fixed effects and drop the standalone variable *PILOT* from the model. The coefficient on the three-way interaction $ResSI \times PILOT \times TEST$ in this specification is −0.809 (−0.395), and it is significant at the 5 (10) percent level for the management guidance (8-K disclosure) sample.

TABLE 7

Reg SHO Shock and the Relation between Residual Short Interest and Voluntary Bad-News Disclosure

	Dependent Variable = *FREQ_BAD_MG* Management Guidance Sample (1)	Dependent Variable = *FREQ_BAD_8K* 8-K Disclosure Sample (2)
ResSI	−0.473***	−0.206**
	(−4.17)	(−2.09)
PILOT	−0.007	−0.001
	(−0.78)	(−0.13)
ResSI × *PILOT*	0.246	0.338**
	(1.26)	(2.12)
ResSI × *TEST*	0.291	0.178
	(1.35)	(1.15)
PILOT × *TEST*	0.005	0.019
	(0.30)	(1.50)
ResSI × *PILOT* × *TEST*	−0.732**	−0.506*
	(−2.06)	(−1.89)
Constant	0.231***	0.658***
	(5.58)	(5.65)
Observations	40,044	45,068
Adjusted R^2	0.073	0.042
Control Variables	Yes	Yes
Calendar Quarter FE	Yes	Yes
Industry FE	Yes	Yes

***, **, * Indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
This table reports the OLS regression results for the change in the relation between residual short interest and voluntary bad-news disclosure for Russell 3000 firms in the pre- and post-Reg SHO periods. *PILOT* is an indicator variable equal to 1 if a firm's stock is selected by the SEC to be removed from price tests as "pilot stock," and 0 otherwise. *TEST* is an indicator variable equal to 1 for the 2005Q2 to 2007Q3 period, and 0 otherwise. The t-statistics are reported in parentheses and are based on standard errors that are clustered by firm.
Other variables are defined in Appendix B.

historical price and implied volatility of put and call options from Ivy DB OptionMetrics, we construct two additional proxies for the presence of negative private information, namely, volatility spreads and volatility skews. These measures reflect how expensive put options are relative to call options, holding the underlying asset the same (the same maturity date and strike price). If options traders possess substantial negative information, then this should drive up the demand and the price of put options relative to call options. This, in turn, would lead to greater disparity in the put-call implied volatility (volatility spreads) and skews. Specifically, following Cremers and Weinbaum (2010), we compute the daily put-call disparity as the weighted average difference in implied volatility between put and call option pairs, which are matched by strike price and maturity date. Similar to Jin et al. (2012), on each day, the difference in implied volatility for the matched pairs is then weighted by the pair's total open interest. We follow Kim and Zhang (2014) and Kim, Li, Lu, and Yu (2016) and compute daily volatility skews as the difference in the implied volatility of out-of-the-money (OTM) put options and that of at-the-money (ATM) call options on the same day. OTM put options are defined as those with a delta in the range of [−0.375, −0.125], while ATM call options are defined as those with a delta in the range of [0.375, 0.625]. If there are multiple put (call) options on a particular day, then the implied volatility of OTM put (ATM call) options is weighted by the option open interest. To obtain quarterly measures of volatility spreads and volatility skews, we average the daily put-call disparity and the daily volatility skews in each calendar quarter, respectively.

In Table 8, Panel A, we first show that residual short interest is positively associated with the concurrent quarterly volatility spreads and volatility skews. We then reestimate our baseline regression model after replacing residual short interest alternately with volatility spreads and volatility skews in quarter t. The results reported in Panel B show that both measures are negatively associated with the frequency of bad-news disclosure in quarter t+1, measured by either bad-news guidance or bad-news 8-Ks. Our inference that managers withhold bad news, therefore, is robust to these alternative proxies for the existence of private bad news. The (untabulated) results based on the firm fixed effect model, where we address concerns that correlated omitted time-invariant firm-specific factors may influence the results, are qualitatively the same.

TABLE 8

Option Market-Based Proxy for Negative Private Information

Panel A: Correlation between Residual Short Interest, Volatility Skews, and Volatility Spreads

	ResSI	***IV_SKEW***
ResSI		
IV_SKEW	**0.27**	
SPREAD	**0.33**	**0.57**

Panel B: Relation between Volatility Skews (Spreads) and Voluntary Bad-News Disclosure

	Dependent Variable = *FREQ_BAD_MG* Management Guidance Sample		**Dependent Variable = *FREQ_BAD_8K* 8-K Disclosure Sample**	
	(1)	**(2)**	**(3)**	**(4)**
IV_SKEW	−0.397***		−0.167**	
	(−3.48)		(−2.03)	
SPREAD		−0.875***		−0.340**
		(−4.00)		(−2.31)
Constant	−0.225***	−0.216***	0.206***	0.187***
	(−2.87)	(−2.75)	(5.15)	(4.66)
Observations	32,040	32,040	40,913	40,913
Adjusted R^2	0.059	0.059	0.063	0.063
Control Variables	Yes	Yes	Yes	Yes
Calendar Quarter FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes

***, **, * Indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
This table reports the results of the analyses that examine the relation between measures of managers' negative private information based on the option market data (volatility skews and spreads) and voluntary bad-news disclosure. Panel A reports Pearson correlations among measures of negative private information from stock and option markets. A correlation coefficient in bold indicates statistical significance at the 1 percent level or lower. Panel B reports the OLS regression results for the relation between voluntary bad-news disclosure and volatility skews and volatility spread, respectively. The frequency of bad-news management guidance and the frequency of bad-news 8-K disclosure are measured in quarter $t+1$, and volatility skews and volatility spreads are measured in quarter t. The t-statistics are reported in parentheses and are based on standard errors that are clustered by firm.
Variables are defined in Appendix B.

Alternative Scaler for Short Interest

It is common in the literature for researchers to scale the level of short interest by the number of shares outstanding (see, for example, Hong et al. 2012; Hanson and Sunderam 2014). One can also scale the level of short interest by the average daily trading volume to obtain what is commonly known as the "days-to-cover ratio." We reestimate our regressions using short interest scaled by the average daily trading volume in the quarter. We calculate the residual measure based on a determinant model similar to the model we used to compute the original residual short interest measure. We find a negative association between this alternative measure of residual short interest and bad-news disclosure, consistent with the results reported in Table 4.[17]

VI. CONCLUSION

In this study, we propose a proxy for managers' private bad news—residual short interest—and use it to examine whether managers disclose or withhold bad news. Validation analyses based on future abnormal stock returns, insider trading, and stock

[17] For our main results tabulated in the paper, we use short interest scaled by total shares outstanding for two reasons. First, scaling short interest by total shares outstanding is the more common practice in the literature. Second, it is difficult to interpret the results based on the level of short interest scaled by trading volume because this ratio is sometimes used as a measure of the risk of "short squeeze." Short squeeze happens when short sellers find it difficult to close their open positions in the face of suddenly rising stock prices, consequently incurring large losses. A high days-to-cover ratio indicates that it would take short sellers a longer time to cover their outstanding positions.

repurchases suggest that residual short interest is a reasonable proxy for the existence and the extent of managerial negative private information. Using management earnings guidance and voluntary 8-K items as two voluntary disclosure measures, we show that the level of residual short interest is negatively associated with the frequency of bad-news disclosure, suggesting that managers, in general, withhold bad news. Cross-sectional analyses reveal that this negative relation is weaker when firms are exposed to higher litigation risk, but stronger when managers have greater incentives to support the stock price.

Our evidence broadens the understanding of managers' incentives to release or withhold bad news. We tackle the challenge of identifying the existence and the extent of negative private information that managers possess by developing a novel measure based on the level of short interest. Given that short selling is becoming increasingly pervasive in the U.S. and many other equity markets worldwide, a deeper understanding of its role and implications would be a fruitful avenue for future research. We note that our study focuses on the disclosure of bad news, not the asymmetry between the disclosures of good and bad news. We focus on the disclosure of bad news as it has been a key issue in the disclosure literature, and the use of residual short interest as a proxy of bad news allows us to provide more clarity on the managerial tendency of bad-news disclosure with a novel approach. An examination of the other side of the equation—good-news disclosure, or asymmetric withholding of good versus bad news—would require a different research design. We leave this endeavor to future research.

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APPENDIX A

Sample Selection Process

Step #	Description	Remaining Firm-Quarter Obs.	# of Unique Firms
1	Total firm-quarter observations for common stocks (share codes 10 or 11) listed in major stock exchanges (exchange codes 1, 2, or 3) between 2001 and 2010 with non-missing returns, price, shares outstanding, and historical SIC codes from CRSP	193,212	8,470
2	Remove observations with stock price lower than $1	182,433	8,139
3	Remove observations with missing short interest data	170,887	7,800
4	Remove observations for which we could not estimate residual short interest due to missing control variables	163,211	7,527
5	Remove observations with missing control variables (validation sample)	152,614	7,178
6a	Limit to firms that issue at least one management guidance in the past four quarters (management guidance sample)	49,393	2,572
6b	Limit to the 2004Q4 to 2010Q4 period, and to those firms that issue at least one voluntary 8-K item during the sample period (8-K disclosure sample)	90,265	5,499

APPENDIX B

Variable Definitions

Variable	Definition
$ABRET_{t+i,t+j}$	Cumulative market-adjusted returns from quarter $t+i$ to $t+j$, where market-adjusted return is the buy-and-hold return minus CRSP value-weighted market index returns.
BAD_8K	An indicator equal to 1 if a firm files at least one bad-news voluntary 8-K item (2.02, 7.01, and 8.01) in calendar quarter $t+1$, and 0 otherwise.
BAD_MG	An indicator equal to 1 if a firm issues at least one bad-news earnings guidance in calendar quarter $t+1$, and 0 otherwise.
BTM	Book-to-market ratio at the end of quarter t.
CAPX	Capital expenditure in quarter t scaled by total assets.
CAR	Three-day market-adjusted return around the filing of voluntary 8-K items (2.02, 7.01, or 8.01), where market-adjusted return is the buy-and-hold return minus CRSP value-weighted market index returns.
CONVERT	An indicator variable equal to 1 if the firm has convertible bonds or convertible preferred stocks outstanding in the most recent fiscal year ending prior to the end of quarter t, and 0 otherwise.
DELTA	The change in the value of a CEO's stock and option holdings when the stock price changes by 1 percent.
ES	Earnings surprise from the earnings announcement, calculated as the difference between quarterly earnings per share and the most recent consensus analyst forecast prior to the earnings announcement, and deflated by share price.
FREQ_BAD_8K	The number of bad-news voluntary 8-K items (2.02, 7.01, and 8.01) filed by a firm in calendar quarter $t+1$. A bad-news item is defined as one with negative residual three-day abnormal return estimated from Equation (1) or Equation (2).
FREQ_BAD_MG	The number of bad-news management guidance issued by a firm in calendar quarter $t+1$, with bad-news guidance defined as a management guidance lower than the most recent consensus analyst forecast.
FREQ_GOOD_8K	The number of good-news voluntary 8-K items (2.02, 7.01, and 8.01) filed by a firm in calendar quarter $t+1$. A good-news item is defined as one with positive residual three-day abnormal return estimated from Equation (1) or Equation (2).
FREQ_GOOD_MG	The number of good-news management guidance issued by a firm in calendar quarter $t+1$, with good-news guidance defined as a management guidance higher than the most recent consensus analyst forecast.
FREQ_MAN_8K	The number of mandatory 8-K items (items except 2.02, 7.01, and 8.01) in 8-Ks filed by a firm in calendar quarter $t+1$.
IO	Institutional ownership, measured by shares owned by institutions divided by total shares outstanding in the most recent calendar quarter.
ISSUE	An indicator variable equal to 1 if the number of shares outstanding, adjusted for stock dividends/splits, increases by more than 10 percent from quarter t to quarter $t+1$, and 0 otherwise (Kwak, Ro, and Suk 2012).
IV_SKEW	The average daily implied volatility skews in quarter t, where the daily implied volatility skews equal the implied volatility of OTM put options minus that of ATM call options. The OTM puts are defined as put option contracts with a delta between −0.375 and −0.125, and the ATM calls are defined as call option contracts with a delta between 0.375 and 0.625. The daily implied volatility of OTM puts (ATM calls) is the open interest-weighted average of all OTM puts (ATM calls) traded during the day.
L1_ABRET	Cumulative market-adjusted returns during quarter t, where market-adjusted return is the buy-and-hold return minus CRSP value-weighted market index returns.
L12_ABRET	Cumulative market-adjusted returns over 12 months before quarter $t+1$ (quarters $t-3$ to t).
L2_ABRET	Cumulative market-adjusted returns during quarter $t-1$, where market-adjusted return is the buy-and-hold return minus CRSP value-weighted market index returns.
LEV	Long-term debt plus current liability divided by total assets in quarter t.
Litigation Risk	The probability of being sued in year $y+1$, estimated based on the model in Kim and Skinner (2012, Table 7, Column 3). More specifically, $SUEProb/(1 - SUEProb) = exp(-7.883 + 0.566 * FPS + 0.518 * TA + 0.982 * SALEGRW + 0.379 * RETURN - 0.108 * SKEWNESS + 25.635 * STDEV + 0.00007 * TURNOVER)$, where *FPS* is an indicator variable for industries that belong to biotech (SIC codes 2833–2836 and 8731–8734), computers (3570–3577 and 7370–7374), electronics (3600–3674), or retail (5200–5961). *TA* is total assets of year y; *SALEGRW* is the sales change from year $y-1$ to year y scaled by total assets of year $y-1$; *RETURN* is the 12-month market-adjusted return in year y; and *SKEWNESS* and *STDEV* are the stock return skewness and standard deviation in year y. *TURNOVER* is trading volume in year y scaled by the beginning-of-year y shares outstanding (divided by 1,000). Year y is the most recent fiscal year ending prior to quarter t.

(continued on next page)

APPENDIX B (continued)

Variable	Definition
LOSS	An indicator variable equal to 1 if a firm reports a loss during quarters $t-3$ to t, and 0 otherwise.
NUM_AN	Number of analysts following a firm during quarter t. The data are obtained from the I/B/E/S summary file.
OPP_NETBUY	The net buying (purchases − sales) by opportunistic top officers of the firm scaled by the total number of shares outstanding, measured in quarter t. We multiply it by 100 for ease of exposition. Firm top officers include CEO, CFO, COO, president, and board chairman. We use Cohen et al.'s (2012) methodology and define opportunistic traders as those who do not place a trade in the same calendar month for three consecutive years.
PILOT	An indicator variable equal to 1 for firms whose stocks are selected by the SEC to be removed from price tests as "pilot stocks," and 0 otherwise.
REPURCHASE	An indicator variable equal to 1 if a firm has announced an open market repurchase program in quarter $t+1$, and 0 otherwise.
ResSI	Residual short interest, residuals from the estimation of Equation (3).
RETVOL	Standard deviation of firm-specific returns from quarter $t-1$ to t.
ROA	Quarterly net income scaled by total assets in quarter t.
SI	The level of aggregate open short positions divided by total shares outstanding at the end of calendar quarter t.
SIZE	The natural logarithm of market value of equity at the end of quarter t.
SPREAD	The average daily put-call disparity in quarter t, where the daily put-call disparity is computed as the weighted average difference in implied volatility between put and call option pairs (implied volatility of put options − implied volatility of call options), which are matched by strike price and maturity date. On each day, the difference in implied volatility for the matched pairs is then weighted by the pair's total open interest.
TEST	An indicator variable equal to 1 for the 2005Q2 to 2007Q3 period, and 0 otherwise.
TREND	The time-trend variable that takes the value ranging from 1 to 40 from 2000Q4 to 2010Q3.
TURNOVER	Sum of monthly trading volume in quarter t divided by shares outstanding.

APPENDIX C

Estimation of Residual Short Interest

	Dependent Variable = *SI*
IO	0.0788***
	(46.42)
CONVERT	0.0102***
	(8.73)
TREND	0.0006***
	(22.11)
Constant	−0.0144***
	(−20.19)
Observations	163,211
Adjusted R^2	0.265

***, **, * Indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
This table reports the regression results from Equation (3) estimated using firm-quarter observations. We use data obtained from Step 4 in Appendix A. The t-statistics are reported in parentheses and are based on standard errors that are clustered by firm.
Variables are defined in Appendix B.