Rev Account Stud (2015) 20:747–774
DOI 10.1007/s11142-014-9313-8

Short sellers and the informativeness of stock prices with respect to future earnings

Michael S. Drake · James N. Myers · Linda A. Myers · Michael D. Stuart

Published online: 24 October 2014

Abstract We examine whether short interest improves the informativeness of stock prices with respect to future earnings. We find that short selling strengthens the relation between current returns and future earnings, especially in settings where short sellers are likely to possess an information advantage, such as when a firm's information environment is weak or when analysts are highly optimistic about future earnings growth. Collectively, our results illustrate the important role that short sellers play in improving the extent to which current stock prices reflect information about future earnings and thus in improving market efficiency.

Keywords Short sellers · Short interest · Future earnings response coefficient (FERC) · Market efficiency

JEL Classification G17 · M40 · M41

1 Introduction

For decades, accounting researchers have investigated determinants of the returns-earnings relation (Kothari 2001). A resulting stream of literature, which focuses on

M. S. Drake (✉)
Marriott School of Management, Brigham Young University, 521 Tanner Building, Provo, UT 84602, USA
e-mail: mikedrake@byu.edu

J. N. Myers · L. A. Myers
Sam M. Walton College of Business, University of Arkansas, Fayetteville, AR 72701, USA

M. D. Stuart
Owen Graduate School of Management, Vanderbilt University, 401 21st Avenue South, Nashville, TN 37203, USA

the extent to which stock prices anticipate *future* earnings, finds that the informativeness of current returns with respect to future earnings news is influenced by the quantity and quality of disclosure (Lundholm and Myers 2002; Ettredge et al. 2005; Orpurt and Zang 2009), management forecasts (Choi et al. 2011), and the extent of analyst coverage and institutional ownership (Ayers and Freeman 2003). The objective of this paper is to further the understanding of the returns-future earnings relation by investigating how the stock positions of sophisticated market participants influence the amount of future earnings news that is embedded in current period stock prices. That is, we investigate whether a group of sophisticated traders—namely, short sellers—can "bring the future forward" by impounding information about future earnings into price (Lundholm and Myers 2002).

Prior research provides evidence that the level of short interest is informative. For example, short interest predicts accounting restatements (Desai et al. 2006) and Securities and Exchange Commission (SEC) enforcement actions for financial misrepresentation (Karpoff and Lou 2010). Short interest also predicts future returns even after controlling for information in fundamental signals and analyst recommendations (Drake et al. 2011). Because the downside risk of short positions is unbounded and because short sellers pay significant loan fees and cannot access proceeds from short sales until their positions are closed (Diether and Werner 2011), short positions are typically taken by sophisticated information arbitrageurs such as hedge funds (Diamond and Verrecchia 1987; Boehmer et al. 2008). Thus we conjecture that short interest will reflect information about future earnings that has yet to be impounded into current period prices.

However, alternative views of the effect of short selling on stock prices exist. First, some short positions, such as those used in hedging strategies, are taken without regard to whether stocks are overvalued and thus are not expected to be informative (Boehmer et al. 2008). Second, despite the fact that the majority of academic studies find that short sellers improve market efficiency, there is evidence that they temporarily depress stock prices below their fundamental values in certain settings. For example, Henry and Koski (2010) find no evidence of informed short selling around seasoned equity offerings but find that higher levels of short interest are associated with higher offering discounts, consistent with manipulative shorting.[1] In addition, critics suggest that aggressive shorting drives stock prices below fundamental values on non-seasoned equity offerings dates, although the evidence is largely anecdotal and is focused on abusive naked short positions.[2] For example, Patrick Byrne, chief executive officer of Overstock.com, suggests that

[1] Gerard and Nanda (1993) develop a model that predicts that short sellers can manipulate seasoned equity offering offer prices to generate profits. Specifically, because seasoned equity offerings are priced at a discount relative to the secondary market price on the day before the offering, informed traders can manipulate the offering price and make large profits by selling heavily in the secondary market just before an offering and then bidding on the underpriced stock afterward. Henry and Koski (2010) empirically confirm these predictions, revealing that short selling makes stock prices less efficient in the days leading up to seasoned equity offerings.

[2] Abusive naked short selling is a practice in which an investor sells a stock short without first arranging to borrow the stock and cannot deliver the stock on the settlement date. Critics argue that naked short positions are used to drive down stock prices and that these short sellers did not intend to deliver the shares when the short position was taken.

Wall Street is destroying small firms through the use of naked short sales,[3] and according to Peter Cardillo, chief market economist at Avalon Partners, "the relaxed regulation of the SEC has led to abuses of short selling that have destroyed many, many companies."[4] These critics argue for expanded regulation of short selling. Note that, if short positions are largely non-information-based or are simply efforts to drive stock prices below fundamental values, we should find no evidence that these positions are associated with the extent to which stock prices anticipate future earnings news.

We conduct our analyses using a sample of approximately 53,000 firm-year observations from 1988 through 2009. To test for an association between short interest and the informativeness of current returns with respect to future earnings news, we employ the future earnings response coefficient (FERC) model based on Collins et al. (1994), as implemented by Lundholm and Myers (2002), Tucker and Zarowin (2006), Orpurt and Zang (2009), and Choi et al. (2011). Consistent with prior research (e.g., Asquith et al. 2005; Boehmer et al. 2010), we use the short interest ratio, defined as the number of shares sold short as a percentage of total shares outstanding, to measure of the level of short interest in a security. Because short sellers target firms with specific characteristics (Drake et al. 2011), the level of short interest in a particular stock is unlikely to be randomly distributed across firms. Thus, following recent methodological recommendations in Lennox et al. (2012), we implement a two-stage Heckman selection model that accounts for short sellers' decisions to short a particular stock.

In our main analyses, we find a positive association between short interest and the FERC. Our models include a large set of control variables that prior research finds to be associated with FERCs, including firm size, profitability, growth, earnings volatility, analyst following, institutional ownership, book-to-market, management forecasts, idiosyncratic volatility, and leverage. Our inferences are robust to the use of either continuous or decile ranked independent variables. Thus the evidence suggests that short sellers do help to bring the future forward by allowing current stock prices to reflect future earnings news, on average.

We then conduct a series of additional tests, which further corroborate our main results. We begin by examining whether our results can be explained by reverse causality. Our primary prediction is that short sellers improve the informativeness of stock prices by trading on information about future earnings, but an alternative explanation could be that short sellers are attracted to firms with high FERCs. To examine this possibility, we replace contemporaneous short interest (in year t) with lagged short interest (in year $t - 1$) and future short interest (in year $t + 1$). We find that lagged short interest is positively associated with the FERC and that future short interest is not associated with the FERC. This suggests that short sellers strengthen the relation between returns and future earnings but do not seek out firms with high prior FERCs.

[3] See "Overstock.com CEO Patrick Byrne on Worldstock, education, and Wall Street corruption" (2011). Available at http://www.overstock.com/Patrick-Byrne/7371/static.html.

[4] See "SEC bans short-selling" in *CNNMoney.com* (September 19, 1998). Available at http://money.cnn.com/2008/09/19/news/economy/sec_short_selling/.

Next, we conduct a series of cross-sectional analyses in specific settings where we expect short sellers to have a greater impact on the pricing of future earnings. First, we predict that short sellers will have a greater impact when the information environment is weak because it is more difficult for the average investor to obtain and process information about future earnings.[5] Second, we predict that short sellers will have a greater impact on the pricing of future earnings when valuation uncertainty is high. Our intuition here is that, when firms are difficult to value, sophisticated traders will only take costly (short) positions when the probability is high that their expectations about future performance are not already reflected in stock price. Third, we predict that short sellers will have a greater impact on the pricing of future earnings when expected future earnings growth is high. This is because firms with high long-term growth forecasts are overvalued [see, for example, De Bondt and Thaler (1990), La Porta (1996), and Easterwood and Nutt (1999)] and short sellers target overvalued firms in order to profit from subsequent stock price declines.

We find that short sellers have the greatest impact on the pricing of future earnings in two of our three cross-sectional settings—when the firm's information environment is weak and when future earnings growth expectations are high. This evidence is consistent with the idea that short sellers improve stock price informativeness by impounding negative future earnings news into stock price in specific settings where prices are otherwise less efficient. In addition, these results are inconsistent with the reverse-causality story—the notion that short sellers are attracted to firms with high FERCs—because the relation between short interest and FERCs is stronger (more positive) for firms with low analyst following, which presumably have weaker information environments.

Our study contributes to the literature in several ways. First, we extend research investigating factors that affect the ability of stock prices to reflect future earnings news by demonstrating that short interest impacts the FERC even after controlling for the effects of other sophisticated market participants (namely, financial analysts and institutional investors). Second, we investigate factors that impact the FERC in settings where stock prices might otherwise be less informative about future earnings. Specifically, we provide evidence that short sellers' influence on the pricing of future earnings is greater in settings where informed trading is most beneficial—namely, when information environments are weak and when expectations about future earnings growth are high. Finally, we contribute to the debate surrounding the value of short selling by adding to new evidence suggesting that short sellers play an important role in reducing securities mispricing (e.g., Saffi and Sigurdsson 2010). For information in short interest to adjust securities prices in a way that is consistent with future earnings realizations, at least some short sellers anticipate future earnings and trade in a way that conveys this information to other market participants.

[5] Collins and Kothari (1989, p. 145) define a firm's information environment as "all sources of information relevant to assessing firm value," and Collins et al. (1987) suggest that the information environment affects the degree to which information about future earnings is impounded into stock prices.

The remainder of this paper is organized as follows. Section 2 discusses prior literature and develops our hypotheses. Section 3 describes our sample and research design. Section 4 provides regression results, and Sect. 5 concludes.

2 Prior literature and development of hypotheses

2.1 The relation between current returns and future earnings

The returns-earnings relation has been the focus of a vast body of research in accounting, starting with Ball and Brown (1968). [See Kothari (2001) for a review of this literature.] Beaver et al. (1980) were among the first to provide evidence that changes in stock prices reflect investor beliefs about future earnings. However, studies in this area note the "embarrassingly low" explanatory power of current earnings for stock returns (Strong and Walker 1993). This motivated researchers to seek improvements to the returns-earnings model. In research that followed, Collins et al. (1994) investigate the relation between current annual returns and *future* annual earnings. They find that a large proportion of current stock returns is explained by future earnings.[6] This suggests that one reason for the weak relation between stock returns and contemporaneous earnings is that investors, at least to some extent, anticipate and price future earnings. Collins et al. (1994) find that adding future earnings as an additional regressor in a returns-earnings model significantly increases the model's explanatory power. They also find that the coefficient on future earnings (i.e., the FERC) is large relative to the coefficient on current earnings.

Several subsequent studies investigate whether variation in firms' disclosure practices affects the strength of the relation between current returns and future earnings. Gelb and Zarowin (2002) and Lundholm and Myers (2002) find that firms with more informative disclosures, as measured by disclosure scores awarded by the Association for Investment Management and Research, have higher FERCs. Other papers investigate the effect of specific types of disclosures on the relation between current returns and future earnings. For example, Ettredge et al. (2005) find that FERCs are higher for firms that began disclosing multiple segments under the Statement of Financial Accounting Standards No. 131, and Orpurt and Zang (2009) find that FERCs are higher when firms prepare their cash flow statements using the direct approach rather than the indirect approach. More recently, Choi et al. (2011) find that FERCs are higher for firms that issue management earnings forecasts and when these forecasts are more frequent and more precise. Overall, these papers find that FERCs increase as more information about future earnings becomes available.

Other studies investigate the effect of sophisticated market participants on the relation between current returns and future earnings. For example, Ayers and Freeman (2003) find that stock prices of firms with greater institutional ownership and more analysts following incorporate future earnings more quickly than do those

[6] In addition, Collins et al. (1994) add future returns to the returns-earnings model to control for unanticipated future earnings.

of other firms, presumably because these market professionals may be better at predicting future earnings than are other investors. Furthermore, Crawford et al. (2011) find that insider trading is associated with higher FERCs, likely because managers have incentives to disclose and profit from their private information. The focus of our study is similar to that of Ayers and Freeman (2003) and Crawford et al. (2011) in that we examine the impact of a group of highly sophisticated market participants, specifically, short sellers, on the FERC. However, we suggest that studying the effect of short sellers on the informativeness of stock prices is especially important because, unlike analysts, institutional investors, and insiders, short sellers have been suggested to have unique incentives to move stock prices *below* their fundamental values and have been targeted with recent regulations banning their activities.[7]

2.2 Short interest and future earnings

Short positions are more costly and inherently more risky than are long positions, so short sellers are likely to be informed traders (Diamond and Verrecchia 1987).[8] Consistent with this intuition, the overwhelming majority of short positions, other than those taken by market makers as part of their buffering activities, are taken by institutional investors and hedge funds (Boehmer et al. 2008).[9] In addition, a growing body of empirical work finds that short interest is negatively associated with future abnormal returns, suggesting that short sellers correctly anticipate stock price declines. [See, for example, Dechow et al. (2001), Desai et al. (2002), Asquith et al. (2005), Boehmer et al. (2010), and Drake et al. (2011).]

Another line of research investigates whether short sellers behave as if they anticipate specific future events that generally result in stock price declines. With respect to short-term short positions, Christophe et al. (2004) find that short selling increases in the days before negative earnings surprises and decreases before positive earnings surprises, while Henry et al. (2013) find that short selling increases before bond rating downgrades. With respect to long-term short positions, which are more closely related to our study, Griffin (2004) finds that short sellers anticipate restatements and corrective disclosures that result in class action lawsuits, and Desai et al. (2006) and Efendi and Swanson (2009) find that short sellers increase the size of their positions in the months leading up to restatement announcements. Karpoff and Lou (2010) provide similar evidence for SEC Accounting and Auditing Enforcement Releases and further show that short sellers anticipate the revelation of financial statement manipulation as well as the severity of this manipulation. Finally, Francis et al. (2008) find that when short interest is unexpectedly high,

[7] Beber and Pagano (2013) investigate the effects of bans on short selling during the recent financial crisis and find that short selling bans lead to decreased market liquidity and hinder price discovery.

[8] With respect to the costs of short selling, short sellers do not have access to the cash proceeds of their sales until their positions are closed, and equity lending contracts include fees estimated at 1.64 % annually for stocks traded on the New York Stock Exchange and 3.74 % annually for stocks traded on the NASDAQ (Diether and Werner 2011).

[9] Boehmer et al. (2008) report that less than 2 % of all short sales are initiated by individual investors.

analysts make larger downward revisions to their earnings forecasts and firms are more likely to miss analysts' consensus forecasts.

Researchers also investigate which information short sellers use to make investment decisions. For example, Dechow et al. (2001) and Drake et al. (2011) find that short interest is associated with publicly available fundamental signals (e.g., valuation ratios, sales growth, etc.) that predict future returns, and Karpoff and Lou (2010) suggest that short sellers use a combination of fundamental analysis and private investigation to inform their investment decisions. In addition, several papers suggest that short sellers trade on indicators of poor financial reporting quality. Specifically, Desai et al. (2006) and Hirshleifer et al. (2011) find that short interest is positively associated with accruals. This evidence suggests that short sellers exploit the implications of current period accruals for future earnings.

In summary, prior research suggests that returns are more informative about future earnings news when higher-quality firm disclosures are made and when certain sophisticated market participants convey their private information. Additionally, short positions are taken by sophisticated information arbitrageurs who anticipate, uncover, and trade on private information in a way that improves market efficiency. Our study combines these two research streams by investigating the impact of short selling on the informativeness of stock prices with respect to future earnings news.

The discussion above suggests that short sellers will only short a stock when the expected benefits exceed the expected costs and that short positions should reflect information about future fundamentals that they believe has yet to be incorporated into stock prices. Thus we predict that short interest will allow future earnings news to be incorporated into current stock prices. Our hypothesis, in the alternative form, is stated as follows:

Hypothesis: The extent to which current stock prices reflect future earnings news is increasing in short interest.

Note, however, that there are several reasons why one may not expect to find a relation between short interest and stock price informativeness. For example, the association between realized future earnings and current returns will not be related to the level of short interest if short interest primarily reflects short seller efforts to reduce prices below fundamental values, if short positions are taken primarily for liquidity or hedging purposes, or if short sellers trade on information that is not related to future earnings.

3 Research design

3.1 Empirical models

3.1.1 Heckman selection model

The level of short interest in a particular stock is not random, and unobservable factors that affect whether an investor shorts a firm may also be associated with

the relation between current returns and future earnings. For example, short interest is higher in firms where firm-specific information predicts future returns (Drake et al. 2011). To address this concern, we follow the methodological recommendations in Lennox et al. (2012) and implement a Heckman two-stage model to help control for a potential selection bias. In the first stage, we model the probability that a firm will be highly shorted using probit regression. The Heckman model requires that an exogenous independent variable, called an "exclusion restriction," be included in the first stage but excluded from the second stage because theory suggests that it is not directly associated with the second stage outcome variable (Lennox et al. 2012). Thus we include $ConvDebt_t$, a variable indicating whether the firm has outstanding convertible debt, as the exclusion restriction. Convertible debt, which generally provides a lower yield than other debt but can be converted into common stock at an amount less than the stock's market value, is commonly priced inefficiently relative to the stock. To capitalize on this mispricing, hedge funds frequently take short positions in the firms' stock and long position in their convertible bonds. As a result, we expect firms with outstanding convertible debt to be more highly shorted than those without outstanding convertible debt, but we have no reason to expect that $ConvDebt_t$ will impact the association between current returns and future earnings. The first-stage model is as follows:

$$\begin{aligned}\Pr(HighSI_t = 1) = f\,(&\lambda_0 + \lambda_1 ConvDebt_t + \lambda_2 MVE_t + \lambda_3 Loss_t + \lambda_4 Growth_t \\ &+ \lambda_5 SdEarn_t + \lambda_6 BTM_t + \lambda_7 IO_t + \lambda_8 Numest_t + \lambda_9 Lev_t \\ &+ \lambda_{10} R_t + \lambda_{11} IdioVol_t + \varepsilon_t)\end{aligned} \quad (1)$$

where t = year t indicator variable; $HighSI$ = an indicator variable set equal to one if short interest as a percentage of shares outstanding on the 15th of the last month of the fiscal year is greater than the sample median, zero otherwise; $ConvDebt$ = an indicator variable set equal to one if the firm has outstanding convertible debt, zero otherwise; MVE = the log of (the number of common shares outstanding at the beginning of fiscal year t multiplied by the stock price at the beginning of fiscal year t); $Loss$ = an indicator variable set to one if the sum of income available to common shareholders before extraordinary items for the years t + 1 through t + 3, deflated by the market value of equity at the beginning of year t is negative, zero otherwise; $Growth$ = the percentage growth in total assets from year t − 1 to year t + 1; $SdEarn$ = the standard deviation of income available to common shareholders before extraordinary items, deflated by the market value of equity at the beginning of fiscal year t, for years t through t + 3; BTM = the ratio of book value of equity to market value of equity at the end of fiscal year t; IO = the percentage of firm shares held by institutional investors at the end of year t; $Numest$ = the natural log of one plus the number of analysts following the firm, from the Institutional Brokers' Estimate System (I/B/E/S), at the end of fiscal year t; Lev = total long-term debt and noncurrent liabilities scaled by the market value of equity at the beginning of year t; R = the buy-and-hold return for year t, measured from the beginning of fiscal year t; and $IdioVol$ = the variance of the residual obtained by fitting the

Carhart (1997) four-factor model to the time-series of daily stock returns.[10] From Model (1), we estimate the inverse Mills ratio (*IMills*), which we include in subsequent models that include the short interest variable to control for potential selection bias.[11][12]

3.1.2 Future earnings response coefficient models

Based on the model in Collins et al. (1994), Lundholm and Myers (2002) develop a model to assess the mix of current versus future earnings news reflected in current returns. Here, current period returns are a function of past and contemporaneous earnings (which jointly reflect the change in current period earnings), as well as 3 years of future earnings. Because the 3 years of future earnings are comprised of expected and unexpected earnings, they include 3 years of future returns in the model. The future returns are correlated with the unexpected portion of future earnings, so the 3 years of future earnings proxies for the expected component of future earnings. Their model can be written as follows (with firm subscripts omitted for parsimony):

$$R_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 X_t + \sum_{i=1}^{3} (\beta_{3i} X_{t+i} + \beta_{4i} R_{t+i}) + \varepsilon_t \quad (2)$$

where X = income available to common shareholders before extraordinary items, deflated by the market value of equity at the beginning of the fiscal year; and all other variables and subscripts are as previously defined.

Following Lundholm and Myers (2002), we estimate a condensed version of Model (2). Here, we sum future annual earnings (X_{t+1}, X_{t+2}, and X_{t+3}) to form X_{t3}, and we calculate future annual buy-and-hold returns (R_{t+1}, R_{t+2}, and R_{t+3}) to form R_{t3}. We also add year and industry fixed effects (using the Fama–French 48 industry classifications) as additional variables to control for cross-sectional correlation and industry-specific correlation in returns. In addition, we estimate each of the models that follow using robust regression to mitigate the influence of outliers, and we control for potential time-series correlation by clustering standard errors by firm.[13] The condensed model is as follows (with firm subscripts omitted for parsimony):

[10] We obtain each of the daily time-series of factors used to estimate the Carhart (1997) four-factor model from Kenneth French's data library, available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

[11] Our inferences from the second-stage models are consistent with those tabulated when $IMills_t$ is excluded.

[12] To further mitigate concerns about selection bias, we perform tests to determine the direction of causality in Sect. 3.1.3.

[13] As recommended by Leone et al. (2014), we use robust regression based on MM-estimation to mitigate the impact of influential outliers. Robust regression uses iterated re-weighted least squares to reduce the weights assigned to extreme observations, resulting in consistent and highly efficient estimation even when the sample includes influential observations.

$$R_t = \beta_1 X_{t-1} + \beta_2 X_t + \beta_3 X_{t3} + \beta_4 R_{t3} + \beta_{Year} + \beta_{Industry} + \varepsilon_t \quad (3)$$

where X_{t3} = the sum of income available to common shareholders before extraordinary items for the years t + 1 through t + 3, deflated by the market value of equity at the beginning of year t; R_{t3} = the buy-and-hold return for the fiscal years t + 1 through t + 3, measured from the beginning of fiscal year t + 1; and all other variables are as previously defined.

Consistent with prior literature, we expect the coefficient on past earnings (β_1) to be negative and the coefficient on contemporaneous earnings (β_2) to be positive. We also expect the coefficient on future earnings (β_3) to be positive and the coefficient on future returns (β_4) to be negative, consistent with Lundholm and Myers (2002). β_2 represents the relation between returns and contemporaneous earnings (controlling for past earnings), while β_3 represents the relation between current returns and future earnings (controlling for future returns).

Our primary interest is in whether the level of short interest affects the ability of stock prices to anticipate future earnings. If short interest improves the pricing of future earnings news, then the FERC (β_3) will be greater for firms with higher short interest. To test our hypothesis, we expand Model (3) by adding short interest and its interactions with the others variables in the basic FERC model (i.e., Model (3)). Following prior literature (for example, Lundholm and Myers 2002; Ettredge et al. 2005; Tucker and Zarowin 2006; Choi et al. 2011), we also expand the FERC model to include additional explanatory variables that have been shown to influence the association between current returns and future earnings. The expanded model is as follows (with firm subscripts omitted for parsimony):

$$\begin{aligned} Rt = {} & \alpha_1 X_{t-1} + \alpha_2 X_t + \alpha_3 X_{t3} + \alpha_4 R_{t3} + \alpha_5 SI_t + \alpha_6 SI_t * X_{t-1} + \alpha_7 SI_t * X_t + \alpha_8 SI_t * X_{t3} \\ & + \alpha_9 SI_t * R_{t3} + \alpha_{10} MVE_t + \alpha_{11} MVE_t * X_{t-1} + \alpha_{12} MVE_t * X_t + \alpha_{13} MVE_t * X_{t3} \\ & + \alpha_{14} MVE_t * R_{t3} + \alpha_{15} Loss_t + \alpha_{16} Loss_t * X_{t-1} + \alpha_{17} Loss_t * X_t + \alpha_{18} Loss_t * X_{t3} \\ & + \alpha_{19} Loss_t * R_{t3} + \alpha_{20} Growth_t + \alpha_{21} Growth_t * X_{t-1} + \alpha_{22} Growth_t * X_t \\ & + \alpha_{23} Growth_t * X_{t3} + \alpha_{24} Growth_t * R_{t3} + \alpha_{25} SdEarn_t + \alpha_{26} SdEarn_t * X_{t-1} \\ & + \alpha_{27} SdEarn_t * X_t + \alpha_{28} SdEarn_t * X_{t3} + \alpha_{29} SdEarn_t * R_{t3} + \alpha_{30} Numest_t \\ & + \alpha_{31} Numest_t * X_{t-1} + \alpha_{32} Numest_t * X_t + \alpha_{33} Numest_t * X_{t3} + \alpha_{34} Numest_t * R_{t3} \\ & + \alpha_{35} IO_t + \alpha_{36} IO_t * X_{t-1} + \alpha_{37} IO_t * X_t + \alpha_{38} IO_t * X_{t3} + \alpha_{39} IO_t * R_{t3} + \alpha_{40} BTM_t \\ & + \alpha_{41} BTM_t * X_{t-1} + \alpha_{42} BTM_t * X_t + \alpha_{43} BTM_t * X_{t3} + \alpha_{44} BTM_t * R_{t3} + \alpha_{45} MFCast_t \\ & + \alpha_{46} MFCast_t * X_{t-1} + \alpha_{47} MFCast_t * X_t + \alpha_{48} MFCast_t * X_{t3} + \alpha_{49} MFCast_t * R_{t3} \\ & + \alpha_{50} IdioVol_t + \alpha_{51} IdioVol_t * X_{t-1} + \alpha_{52} IdioVol_t * X_t + \alpha_{53} IdioVol_t * X_{t3} \\ & + \alpha_{54} IdioVol_t * R_{t3} + \alpha_{55} Lev_t + \alpha_{56} Lev_t * X_{t-1} + \alpha_{57} Lev_t * X_t + \alpha_{58} Lev_t * X_{t3} \\ & + \alpha_{59} Lev_t * R_{t3} + \alpha_{60} IMills_t + \alpha_{61} IMills_t * X_{t-1} + \alpha_{62} IMills_t * X_t + \alpha_{63} IMills_t * X_{t3} \\ & + \alpha_{64} IMills_t * R_{t3} + \alpha_{Year} + \alpha_{Industry} + \varepsilon_t \end{aligned} \quad (4)$$

where SI = short interest as a percentage of shares outstanding on the 15th of the last month of the fiscal year; $MFCast$ = an indicator variable set to one if

management issues an earnings per share (EPS) forecast during the fiscal year, zero otherwise; *IMills* = the inverse Mills ratio derived from estimating Model (1); and all other variables and subscripts are as previously defined.

In this model, $SI_t{*}X_{t3}$ is the term of interest; the coefficient on this term indicates whether more or less future earnings news is revealed in stock price when short interest is higher. Our hypothesis predicts a positive coefficient on $SI_t{*}X_{t3}$, indicating that higher levels of short interest move stock prices toward fundamental values. However, the coefficient on $SI_t{*}X_{t3}$ will be nonpositive if short interest primarily reflects short seller efforts to depress stock prices below fundamental values, if short positions are taken primarily for liquidity or hedging purposes, or if future earnings is already impounded into price.

We add MVE_t to control for differences in firm information environments related to variation in firm size and liquidity. We include $Loss_t$ because it may be more difficult to predict negative future earnings than positive future earnings, and we include $Growth_t$ because high growth firms are likely to have higher FERCs. We include $SdEarn_t$ because more volatile earnings are more difficult to predict. We include $Numest_t$ to control for differences in information environments related to the number of analysts following, and we include IO_t to control for short interest constraints (Asquith et al. 2005; Nagel 2005). We include BTM_t to control for differences in valuation multiples across firms, and we include $MFCast_t$ because Choi et al. (2011) find that FERCs are greater when firms issue management earnings forecasts. We include $IdioVol_t$ to control for information uncertainty. Finally, we include Lev_t because leverage is negatively associated with the earnings response coefficient (Dhaliwal et al. 1991; Core and Schrand 1999). In addition, we estimate Model (4) using the yearly decile ranks of all continuous independent variables, scaled to range between −0.5 and 0.5, to mitigate concerns that outliers are influencing our results.

3.1.3 Tests to determine the direction of causality

We perform additional analyses to address potential concerns about reverse causality—that firms with high associations between returns and future earnings are more attractive to short sellers. From Model (4), we remove SI_t and its interactions with X_{t-1}, X_t, X_{t3}, and R_{t3}, and we replace these variables with lagged short interest (SI_{t-1}) and future short interest (SI_{t+1}) and their interactions with X_{t-1}, X_t, X_{t3}, and R_{t3}. We expect that lagged short interest will increase the association between current returns and future earnings, indicating that short sellers trade on information that is not fully impounded into stock price. We also expect that future short interest will not increase the FERC. The model is as follows (with firm subscripts omitted for parsimony):

$$\begin{aligned} Rt = {} & \delta_1 X_{t-1} + \delta_2 X_t + \delta_3 X_{t3} + \delta_4 R_{t3} + \delta_5 SI_{t-1} + \delta_6 SI_{t-1} * X_{t-1} + \delta_7 SI_{t-1} * X_t \\ & + \delta_8 SI_{t-1} * X_{t3} + \delta_9 SI_{t-1} * R_{t3} + \delta_{10} SI_{t+1} + \delta_{11} SI_{t+1} * X_{t-1} + \delta_{12} SI_{t+1} * X_t \\ & + \delta_{13} SI_{t+1} * X_{t3} + \delta_{14} SI_{t+1} * R_{t3} + \delta Controls + \delta_{Year} + \delta_{Industry} + \varepsilon_t \end{aligned} \tag{5}$$

where *Controls* = all controls included in Model (4)—MVE_t, $Loss_t$, $Growth_t$, $SdEarn_t$, $Numest_t$, IO_t, BTM_t, $MFCast_t$, $IdioVol_t$, Lev_t, and *IMills*—and each

interacted with X_{t-1}, X_t, X_{t3}, and R_{t3}, where these variables are as previously defined; and all other variables are as previously defined.

In Model (5), our variables of interest are $SI_{t-1}*X_{t3}$ and $SI_{t+1}*X_{t3}$. A positive and significant coefficient on $SI_{t-1}*X_{t3}$ would indicate that short sellers improve the relation between returns and future earnings, and a nonpositive coefficient on $SI_{t+1}*X_{t3}$ would provide evidence that short sellers are generally not attracted to firms with higher FERCs in prior years.

3.1.4 Tests for moderating factors

We also examine settings where we expect the influence of short sellers on the future earnings-returns relation to be especially strong. Grossman and Stiglitz (1980) show that informed traders have the largest impact on price when they have high quality information. Thus we identify settings where positions of short sellers are likely to reflect high quality information about the firm (rather than a non-information-based hedging strategy). Specifically, we explore settings where firms have weak information environments, firms are difficult to value, and expectations about future earnings are optimistic. In each of these settings, we expect short sellers to be more likely to uncover information that, once traded on, will improve the informativeness of stock prices and strengthen the relation between current period returns and future earnings. We discuss each setting in turn below.

First, we examine the influence of the information environment on the effect of short selling. Firms with strong information environments provide more forthcoming disclosure and more voluntary disclosures (Lang and Lundholm 1993) and are followed by more information intermediaries such as sell-side analysts (Bhushan 1989; Lang and Lundholm 1996). One of the primary roles of sell-side analysts is to forecast future earnings, and a long line of literature provides evidence that these forecasts are value-relevant. [See, for example, Givoly and Lakonishok (1979), Lys and Shon (1990), and Gleason and Lee (2003).] As a result, when more analysts follow firms, short sellers will have less unexploited information to capitalize on.[14] Thus it should be more difficult for market participants to obtain and trade on information about future earnings when the information environment is weak.[15] To proxy for the strength of the information environment, we use the number of analysts following the firm from I/B/E/S.[16] Furthermore, Pownall and Simko (2005) find that short sellers play a more important role as information intermediaries for firms with low analyst following than for firms with high analyst following. Because

[14] When more analysts follow firms, Ayers and Freeman (2003) find that stock prices reflect future earnings more quickly, and Piotroski and Roulstone (2004) find that more firm-specific, industry, and market-level information is impounded into stock price.

[15] It may be difficult to close short positions in firms with weak information environments because these firms are less heavily traded (Roulstone 2003). This implies that short sellers will take short positions in firms with weak information environments only if they are confident that they have high quality information about future earnings.

[16] The belief that analysts should be better at predicting future performance than are other investors is consistent with the work of Ayers and Freeman (2003), who find that stock prices reflect future earnings more quickly when firms are followed by more analysts.

the information environment of firms with fewer analysts following is weaker, we expect short sellers to have the greatest impact on the informativeness of current returns with respect to future earnings when analyst following is low (i.e., below the sample median).

Second, we examine how valuation uncertainty impacts the effect of short sellers on the FERC. When valuation uncertainty is high, estimates of fundamental value are less reliable because information acquisition costs are higher and future firm performance is unpredictable (Jiang et al. 2005). Furthermore, investors' behavioral biases are amplified when valuation uncertainty is high (Kumar 2009). Jiang et al. (2005) suggest that overconfident investors trade more aggressively on their private information signals when valuation uncertainty is high, resulting in overvalued stocks. Thus difficult to value firms provide a greater opportunity for sophisticated arbitrageurs to profit from their superior information processing abilities, and these parties should take costly positions only when their expectations about future performance are based on high quality information that is not already reflected in stock prices. Thus short sellers should have a greater impact on the pricing of future earnings when valuation uncertainty is high, compared to when it is low. Following Kumar (2009), we use idiosyncratic volatility to proxy for valuation uncertainty. We expect short sellers to have the greatest impact on the informativeness of current returns for future earnings when idiosyncratic volatility is high (i.e., above the sample median).

Finally, we examine the influence of expected future growth on the effect of short selling. Prior research provides evidence that analysts' growth forecasts are "overly optimistic" and "too extreme" (De Bondt and Thaler 1990; La Porta 1996; Easterwood and Nutt 1999; Chan et al. 2003). For example, Easterwood and Nutt (1999) find that analysts underreact to negative information and overreact to positive information, and La Porta (1996) finds that the returns of firms with high growth forecasts are significantly lower than those of firms with low growth forecasts. However, taking short positions in stocks with high expectations about future growth can be costly because of the risk of a short squeeze.[17] Thus short sellers should only take positions in stocks with high expected future growth when they have high quality information about future earnings. To proxy for market expectations about future earnings growth, we use analysts' long-term growth forecasts (LTG) from I/B/E/S.[18] This proxy is appropriate because the FERC model employs a future earnings variable estimated over a long horizon (specifically, 3 years) and analysts' long-term growth forecasts in I/B/E/S are generally for horizons of 3–5 years. Also, prior research finds that analysts' long-term growth forecasts tend to be optimistic (De Bondt and Thaler 1990; La Porta 1996; Easterwood and Nutt 1999; Chan et al. 2003; Barniv et al. 2009; Da and Warachka 2011), so firms with the highest growth forecasts are, on average, those firms where analysts' forecasts are the most optimistic (La Porta 1996; Dechow et al. 2010). We

[17] A short squeeze occurs when the stock price begins to rise and short sellers are forced to close their positions by buying shares, which further increases the stock price and leads to further short seller losses.

[18] Analysts' long-term growth forecasts are a common proxy for the market's expectations about future growth (La Porta 1996; Chan et al. 2003; Barniv et al. 2009; Da and Warachka 2011).

expect short sellers to play a more important role in the pricing of future earnings for the subsample of firms with the most optimistic earnings growth forecasts (i.e., above the sample median).

To examine whether short interest strengthens the returns-future earnings relation in settings where the firm's information environment is weak, where valuation uncertainty is high, and where the market is most optimistic about future earnings growth, we estimate the following model (with firm subscripts omitted for parsimony):

$$\begin{aligned} Rt = {} & \varphi_1 X_{t-1} + \varphi_2 X_t + \varphi_3 X_{t3} + \varphi_4 R_{t3} + \varphi_5 SI_t + \varphi_6 SI_t * X_{t-1} + \varphi_7 SI_t * X_t \\ & + \varphi_8 SI_t * X_{t3} + \varphi_9 SI_t * R_{t3} + \varphi_{10} Group_t + \varphi_{11} Group_t * X_{t-1} \\ & + \varphi_{12} Group_t * X_t + \varphi_{13} Group_t * X_{t3} + \varphi_{14} Group_t * R_{t3} + \varphi_{15} Group_t * SI_t \\ & + \varphi_{16} Group_t * SI_t * X_{t-1} + \varphi_{17} Group_t * SI_t * X_t + \varphi_{18} Group_t * SI_t * X_{t3} \\ & + \varphi_{19} Group_t * SI_t * R_{t3} + \varphi Controls + \varphi_{Year} + \varphi_{Industry} + \varepsilon_t \end{aligned} \tag{6}$$

where $Group_t = LowNumest_t$, $HighIdioVol_t$, or $HighLTG_t$; $LowNumest_t$ = an indicator variable set to one if the number of analysts following the firm in the last month of the fiscal year is less than the sample median, zero otherwise; $HighIdioVol_t$ = an indicator variable set to one if $IdioVol_t$ measured over the fiscal year is greater than the sample median, zero otherwise; $HighLTG_t$ = an indicator variable set to one if the median analyst long-term growth forecast measured during the last month of the fiscal year is greater than the sample median, zero otherwise; and all other variables are as previously defined.[19]

In Model (6), $Group_t*SI_t*X_{t3}$ is the variable of interest. The coefficient on $Group_t*SI_t*X_{t3}$ will be positive and significant if short interest increases the informativeness of current returns with respect to future earnings to a greater extent when the information environment is weak, when valuation uncertainty is greater, and when long-term growth forecasts are high, respectively.

3.2 Sample selection

Our sample consists of observations from 1988 through 2009.[20] We obtain monthly short interest for all firms listed on US stock exchanges beginning in 2003 from the Compustat Monthly Securities Database. To measure short interest from 1988 through 2002, we obtain short interest data directly from the NYSE, AMEX, and NASDAQ stock exchanges and from an independent vendor.[21] Each

[19] We include all control variables from Model (4) when estimating Model (6) except that, when we partition the sample on the median of $Numest_t$, we remove $Numest_t$ and the related interactions from the model.

[20] Our sample period ends in 2009 because our models require three years of future earnings and returns.

[21] Specifically, we obtain less than 1 % of our total observations from the online vender shortsqueeze.com. These data cover a period for which we could not obtain short interest data directly from the NASDAQ.

month, the major indexes report open short positions as of the 15th of that month (or the last business day before the 15th). We obtain all accounting-related data from the Annual Industrial Compustat files and monthly returns used to calculate buy-and-hold returns from the Center for Research in Security Prices (CRSP). We obtain analyst following and long-term growth forecasts from I/B/E/S and management forecast data from the First Call Company Issued Guidance file. We delete all observations with a book value of equity less than zero (Collins et al. 1999; Easton et al. 2002; Pae et al. 2010). Following Tucker and Zarowin (2006), we minimize the effect of outliers by deleting observations in the top or bottom 1 % of the distribution of all continuous variables by year. Our final sample consists of 53,368 firm-year observations.

4 Results

4.1 Descriptive statistics

Table 1, Panel A, presents descriptive statistics for our sample observations. The mean (median) annual buy-and-hold return is 15.6 (6.7) %, and the mean (median) 3-year-ahead return is 42.3 (18.1) %. Mean (median) earnings is 2.6 (5.0) % of market value of equity, and the mean (median) 3-year-ahead earnings is 11.2 (14.9) % of market value of equity. The mean (median) standard deviation of 3-year-ahead earnings is 8.1 (4.1) %, and approximately 28 % of sample observations report negative future income available to common shareholders before extraordinary items. The mean (median) book-to-market ratio is 0.63 (0.52). The mean SI_t (of 2.1 %) is much larger than the median SI_t (of 0.7 %), revealing that the SI_t is large for some sample observations. The mean (median) beginning of year t market value of equity (MVE_t) is \$2.062 billion (\$263 million). Growth in assets from year t − 1 through t + 1 varies greatly across observations, with a mean (median) of 30.3 (15.3) %. Institutional investors are active in our sample firms, with mean (median) shareholdings of 43.9 (42.6) %. Approximately 20 % of sample observations issue management EPS forecasts. The mean (median) number of analysts following is 5.4 (3.0). Finally, the mean (median) Lev_t is 0.58 (0.26).

Table 2 presents Pearson (above the diagonal) and Spearman (below the diagonal) correlations for our sample observations. Consistent with Lundholm and Myers (2002) and Choi et al. (2011), we find that the earnings variables, X_{t-1}, X_t, and X_{t3}, are highly correlated. Furthermore, the correlations between current returns (R_t) and current earnings (X_t) and between current returns (R_t) and future earnings (X_{t3}) are high as expected, as is the correlation between future returns (R_{t3}) and future earnings (X_{t3}). We also find that short interest (SI_t) is not highly correlated with the other variables of interest (X_{t-1}, X_t, X_{t3}, and R_{t3}) and that the correlations between SI_t and the control variables are generally low except for between SI_t and MVE_t, BTM_t, IO_t, $MFCast_t$, and $Numest_t$.

Table 1 Descriptive statistics

Variable	*N*	Mean	SD	25th percentile	50th percentile	75th percentile
R_t	53,368	0.1557	0.5896	−0.2000	0.0667	0.3646
R_{t3}	53,368	0.4230	1.1105	−0.2760	0.1808	0.7618
X_{t-1}	53,368	0.0316	0.1138	0.0083	0.0517	0.0839
X_t	53,368	0.0256	0.1214	0.0037	0.0499	0.0818
X_{t3}	53,368	0.1124	0.4006	−0.0295	0.1493	0.2883
SI_t	53,368	0.0214	0.0341	0.0009	0.0068	0.0267
MVE_t (millions)	53,368	2,062.2	6,876.2	62.9	263.1	1,127.2
$Loss_t$	53,368	0.2783	0.4482	0.0000	0.0000	1.0000
$Growth_t$	53,368	0.3025	0.6121	−0.0140	0.1532	0.4226
$SdEarn_t$	53,368	0.0811	0.1150	0.0192	0.0409	0.0930
BTM_t	53,368	0.6290	0.4749	0.3105	0.5179	0.8023
IO_t	53,368	0.4386	0.2876	0.1840	0.4259	0.6707
$MFCast_t$	53,368	0.2002	0.4001	0.0000	0.0000	0.0000
$Numest_t$ (not logged)	53,368	5.4358	6.3102	1.0000	3.0000	8.0000
Lev_t	53,368	0.5818	0.8913	0.0548	0.2639	0.7328
$ConvDebt_t$	53,368	0.1327	0.3393	0.0000	0.0000	0.0000
LTG_t	33,330	16.4285	9.6412	10.5000	15.0000	20.0000
$IdioVol_t$	53,083	0.0012	0.0014	0.0003	0.0007	0.0016

This table presents descriptive statistics for our sample firms from 1988 through 2009. All variables are truncated at the 1st and 99th percentiles

R_t = the buy-and-hold return for year t measured over the 12-month period measured from the beginning of fiscal year t, X_t = income available to common shareholders before extraordinary items, deflated by the market value of equity at the beginning of fiscal year t, X_{t3} = the sum of income available to common shareholders before extraordinary items for the years t + 1 through t + 3, deflated by the market value of equity at the beginning of fiscal year t, R_{t3} = the buy-and-hold return for the fiscal years t + 1 through t + 3 measured from the beginning of fiscal year t + 1, SI_t = short interest as a percentage of shares outstanding as reported in CRSP measured on the 15th of the last month of the fiscal year, MVE_t = the log of (the number of common shares outstanding at the beginning of the year t multiplied by the stock price at the beginning of the fiscal year t), $Loss_t$ = an indicator variable set to one if X_{t3} is negative, zero otherwise, $Growth_t$ = the percentage growth in total assets from year t − 1 to year t + 1, $SdEarn_t$ = the standard deviation of *X* for years t through t + 3, BTM_t = the ratio of the book value of equity to the market value of equity at the end of fiscal year t, IO_t = the percentage of firm shares held by institutional investors at the end of year t, $MFCast_t$ = an indicator variable set equal to one if a management EPS forecast is issued during the fiscal year, zero otherwise, $Numest_t$ = the natural log of one plus the number of analysts following the firm, from I/B/E/S, at the end of fiscal year t, Lev_t = total long-term debt and noncurrent liabilities scaled by the market value of equity at the beginning of year t, $ConvDebt_t$ = an indicator variable set equal to one if the firm has outstanding convertible debt, zero otherwise, LTG_t = the long-term analyst growth forecast, provided by I/B/E/S, measured as of the last month of the fiscal year, $IdioVol_t$ = the variance of the residual obtained by fitting the Carhart (1997) four-factor model to the time-series of daily stock returns, $Group_t$ = $LowNumest_t$, $HighIdioVol_t$, or $HighLTG_t$, $LowNumest_t$ = an indicator variable set to one if the number of analysts following the firm is less than the sample median, zero otherwise, $HighIdioVol_t$ = an indicator variable set to one if $IdioVol_t$ measured over the fiscal year is greater than the sample median, zero otherwise, $HighLTG_t$ = an indicator variable set to one if the median analyst growth forecast is greater than the sample median, zero otherwise

Table 2 Pearson and Spearman Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) R_t		−0.11	−0.04	0.19	0.16	−0.02	−0.04	−0.11	0.26	−0.11	−0.32	0.03	−0.04	0.02	0.06	−0.01	0.09	−0.02
(2) R_{t3}	−0.08		0.01	−0.01	0.36	−0.08	−0.03	−0.27	−0.04	−0.10	0.18	−0.06	−0.06	−0.04	0.07	−0.01	−0.03	0.07
(3) X_{t-1}	0.07	0.09		0.45	0.29	−0.05	0.05	−0.31	0.07	−0.18	0.02	0.10	0.05	0.11	0.01	−0.06	−0.17	−0.32
(4) X_t	0.40	0.09	0.55		0.44	−0.06	0.05	−0.37	0.16	−0.35	−0.11	0.10	0.03	0.10	0.03	−0.06	−0.13	−0.33
(5) X_{t3}	0.34	0.51	0.36	0.52		−0.07	0.04	−0.68	0.06	−0.42	−0.05	0.09	0.03	0.08	0.12	−0.04	−0.15	−0.23
(6) SI_t	0.00	−0.10	−0.09	−0.12	−0.09		0.04	0.06	0.05	0.00	−0.15	0.47	0.19	0.31	−0.07	0.17	0.12	−0.11
(7) MVE_t	−0.03	0.03	0.12	0.07	0.10	0.57		−0.10	−0.03	−0.10	−0.12	0.21	0.08	0.27	−0.02	0.07	−0.11	−0.16
(8) $Loss_t$	−0.19	−0.39	−0.33	−0.41	−0.78	0.02	−0.23		−0.05	0.48	0.11	−0.17	−0.08	−0.18	−0.05	0.05	0.19	0.31
(9) $Growth_t$	0.30	−0.03	0.18	0.29	0.23	0.08	0.06	−0.19		−0.09	−0.26	0.02	−0.03	0.07	−0.05	0.02	0.26	−0.02
(10) $SdEarn_t$	−0.19	−0.22	−0.20	−0.26	−0.43	−0.11	−0.38	0.55	−0.22		0.31	−0.15	−0.08	−0.18	0.12	0.05	0.06	0.28
(11) BTM_t	−0.35	0.17	0.10	0.03	−0.01	−0.29	−0.27	0.07	−0.33	0.33		−0.17	−0.08	−0.27	0.28	−0.02	−0.20	0.17
(12) IO_t	0.08	−0.01	0.08	0.08	0.09	0.58	0.67	−0.18	0.06	−0.24	−0.15		0.34	0.60	−0.04	0.13	−0.05	−0.41
(13) $MFCast_t$	−0.03	−0.02	0.02	−0.01	0.01	0.29	0.27	−0.08	−0.01	−0.13	−0.07	0.33		0.28	−0.05	0.01	0.00	−0.11
(14) $Numest_t$	0.06	0.01	0.09	0.07	0.09	0.51	0.73	−0.18	0.13	−0.29	−0.26	0.62	0.28		−0.02	0.12	−0.08	−0.37
(15) Lev_t	0.10	0.11	0.17	0.21	0.22	−0.10	0.08	−0.12	−0.07	0.10	0.35	0.04	−0.03	0.04		0.11	−0.27	−0.06
(16) $ConvDebt_t$	−0.01	−0.02	−0.07	−0.07	−0.05	0.18	0.13	0.05	0.01	0.06	−0.02	0.12	0.01	0.12	0.19		0.02	−0.04
(17) LTG_t	0.02	−0.14	−0.22	−0.23	−0.21	0.14	−0.26	0.17	0.29	0.09	−0.31	−0.01	0.03	−0.08	−0.49	0.03		0.36
(18) $IdioVol_t$	−0.18	−0.06	−0.33	−0.34	−0.30	−0.17	−0.59	0.36	−0.07	0.45	0.09	−0.42	−0.10	−0.40	−0.26	−0.04	0.50	

This table presents the Pearson (above the diagonal) and Spearman (below the diagonal) correlations between variables. Variable definitions are provided in Table 1

4.2 Empirical results

4.2.1 First-stage Heckman model

We present the results from estimating Model (1), the first stage probit regression in our Heckman two-stage selection model, in Table 3. The discriminatory power of the model is excellent since the area under the ROC curve is 0.80 (Hosmer and Lemeshow 2005). Consistent with our expectations that firms with convertible debt are more highly shorted than those without convertible debt, we find that the coefficient on the exclusion restriction, $ConvDebt_t$, is positive and significant. We also find that $HighSI_t$ is positively associated with $Loss_t$, $Growth_t$, IO_t, $Numest_t$, Lev_t, and $IdioVol_t$ and is negatively associated with MVE_t, BTM_t, and R_t.

4.2.2 Main tests of our hypothesis

We now present the results from tests of our main hypothesis using Models (3) and (4). Following recent recommendations in Leone et al. (2014) on how to mitigate the effects of influential observations, we estimate these models using robust regression. Thus the number of observations used to estimate each model varies. Table 4 presents the results from tests of our hypothesis—that FERCs are increasing in short interest. Column (1) presents the estimation results for Model (3), the basic FERC model. Columns (2) and (3) present the estimation results for Model (4), which includes SI_t and its interaction with the other variables in the basic FERC model and also includes control variables from prior studies; in Column (2), we include the continuous measures of all independent variables, and in Column (3), we replace the continuous variables with decile ranks of all continuous variables and interact these with the ranked variables from the basic FERC model. We present the results using ranked variables to facilitate the interpretation of economic magnitudes.

In Column (1), we confirm that our results resemble those reported in prior studies. Here, we find that the coefficient on X_t (the earnings response coefficient) is positive and significant (p value <0.01), confirming that current returns are increasing in current earnings. Furthermore, we find that the coefficient on X_{t3} is positive and significant (p value <0.01), indicating that future earnings are reflected in current returns, consistent with Lundholm and Myers (2002) and Choi et al. (2011).

In Column (2), we find that the coefficients on the variables from the basic FERC model remain significant. Importantly, consistent with our hypothesis, the coefficient on the variable of interest, $SI_t{*}X_{t3}$, is positive and significant (p value <0.01). This suggests that, when short interest is higher, current returns are more informative about future earnings news even after controlling for other variables known to affect the association between current returns and future earnings. Similarly, in Column (3), we confirm that this result is robust to ranking all continuous independent variables.

The results in Column (3) can be used to assess the economic significance of our findings. Because our model is similar in spirit to that of Mashruwala et al. (2006),

Table 3 Determinants of high short interest

	Model 1	
	Pr($HighSI_t = 1$)	
	Coef.	p value
Intercept	−1.067***	<.0001
$ConvDebt_t$	0.535***	<.0001
MVE_t	−0.000***	<.0001
$Loss_t$	0.285***	<.0001
$Growth_t$	0.123***	<.0001
$SdEarn_t$	0.027	0.6772
BTM_t	−0.410***	<.0001
IO_t	1.127***	<.0001
$Numest_t$	0.472***	<.0001
Lev_t	0.014*	0.0513
R_t	−0.064***	<.0001
$IdioVol_t$	30.269***	<.0001
N	53,368	
Freq. of Dep Var = 1	26,521	
Max-rescaled R^2	0.340	
Area under the ROC curve	0.800	

This table presents results from estimating Model (1), the first stage Heckman model, using a probit regression in which the dependent variable is $HighSI_t$. p values are reported to the right of the coefficient estimates. All variables are truncated at the 1st and 99th percentiles. Variable definitions are provided in Table 1. ***, **, and * represent significance at the 1, 5, and 10 % levels, respectively

we follow their methodology (and terminology) when interpreting the interactions of two ranked variables. Following Mashruwala et al. (2006), all continuous independent variables are ranked into deciles and scaled to range between −0.5 and 0.5, a value of 0 for each variable is meaningful and represents the median level (Jaccard and Turrisi 2003). We find that the coefficient on X_{t3} is 0.521 (p value <0.01). This coefficient represents the difference in stock returns for a hypothetical firm in the highest decile of X_{t3} versus a hypothetical firm in the lowest decile of X_{t3}, both with median levels of the other independent variables in the model. The coefficient on the interaction term SI_t*X_{t3}, 0.053, can be interpreted as the additional increase in this difference when short interest is in the highest (vs. lowest) decile of SI_t for these hypothetical firms. Thus, for a firm in the highest X_{t3} decile ($X_{t3} = 0.5$) and the highest SI_t decile ($SI_t = 0.5$), the average stock return is 27.4 % [(0.521 × 0.5) + (0.053 × 0.5 × 0.5)], while for a firm in the highest X_{t3} decile ($X_{t3} = 0.5$) and the lowest SI_t decile ($SI_t = -0.5$), the average stock return falls to 24.7 % [(0.521 × 0.5) + (0.053 × 0.5 × −0.5)]. This decline, of almost 3 %, is economically significant.

Overall, the results are consistent with our hypothesis and suggest that current returns incorporate future earnings news to a greater extent when short interest is higher. This is consistent with the argument that short sellers anticipate future earnings

Table 4 The association between short interest and the FERC

	Model 3		Model 4		Model 4	
	(1)		(2)		(3)	
	Coef.	*p* value	Coef.	*p* value	Coef.	*p* value
Intercept	0.072***	<.0001	0.107***	<.0001	−0.064***	<.0001
X_{t-1}	−0.496***	<.0001	−0.331***	<.0001	−0.161***	<.0001
X_t	1.083***	<.0001	1.732***	<.0001	0.338***	<.0001
X_{t3}	0.404***	<.0001	0.819***	<.0001	0.521***	<.0001
R_{t3}	−0.075***	<.0001	−0.088***	<.0001	−0.230***	<.0001
SI_t			−0.701***	<.0001	−0.012**	0.0249
SI_t*X_{t-1}			0.089***	0.8479	−0.025	0.1848
SI_t*X_t			−3.313***	<.0001	−0.028	0.1916
SI_t*X_{t3}			**0.853*** **	**<.0001**	**0.053*** **	**0.0095**
SI_t*R_{t3}			−0.133***	0.0058	0.004	0.8244
Inverse Mills ratio	Excluded		Included		Included	
Controls	Excluded		Included		Included	
Industry FE	Included		Included		Included	
Year FE	Included		Included		Included	
Decile ranked	No		No		Yes	
N	51,607		51,522		53,036	
Adjusted R^2	0.357		0.577		0.603	

This table presents robust regression estimation results for Models (3) and (4) in which the dependent variable is current returns (R_t). Column (1) presents the results from estimating Model (3) (i.e., the basic FERC model), Column (2) presents results from estimating Model (4), and Column (3) presents results from estimating Model (4) where all continuous variables are ranked into deciles. *p* values are reported to the right of the coefficient estimates and are based on *t* statistics clustered by firm. All variables are truncated at the 1st and 99th percentiles. Variable definitions are provided in Table 1. Industry fixed-effects (based on the Fama–French 48 industry classifications) and year fixed-effects are included in the model but are not reported. Coefficients of interest are in bold. ***, **, and * represent significance at the 1, 5, and 10 % levels, respectively, using a two-tailed *t* test, except for on SI_t*X_{t3}, where a directional prediction is made

and trade in a way that impounds this information into price. Thus our results illustrate the important role that short sellers play in improving market efficiency.

In Table 5, we estimate Model (5) to examine whether greater short interest leads to improved FERCs *or* whether firms with higher associations between current returns and future earnings are more attractive to short sellers. We find that the coefficient on SI_{t-1}*X_{t3} is positive and significant, suggesting that short sellers trade on information that has not already been impounded into price, thus increasing FERCs. Importantly, we find that the coefficient on SI_{t+1}*X_{t3} is insignificant, providing evidence that the positive relation between short interest and the FERC is not a result of short sellers being more attracted to firms with greater prior FERCs.

Our next analyses examine whether greater short interest improves price informativeness to a greater extent when the information environment is weak, when valuation uncertainty is high, and when market expectations of long-term

Table 5 The Association between short interest lags and leads and the FERC

	Model 5	
	Coef.	*p* value
Intercept	−0.129***	<.0001
X_{t-1}	−0.303***	<.0001
X_t	1.825***	<.0001
X_{t3}	0.814***	<.0001
R_{t3}	−0.089***	<.0001
SI_{t-1}	−0.659***	<.0001
SI_{t-1}*X_{t-1}	2.275***	0.0002
SI_{t-1}*X_t	−3.317***	<.0001
SI_{t-1}*X_{t3}	**0.404***	**0.0665**
SI_{t-1}*R_{t3}	−0.216***	0.0002
SI_{t+1}	0.009	0.8703
SI_{t+1}*X_{t-1}	−0.397	0.5156
SI_{t+1}*X_t	−0.101	0.8594
SI_{t+1}*X_{t3}	**−0.179**	**0.3576**
SI_{t+1}*R_{t3}	0.044	0.3912
Inverse Mills ratio	Included	
Controls	Included	
Industry FE	Included	
Year FE	Included	
N	38,050	
Adjusted R^2	0.592	

This table presents the robust regression estimation results for Model (5) in which the dependent variable is current returns (R_t). *p* values are reported to the right of the coefficient estimates and are based on *t* statistics clustered by firm. All variables are truncated at the 1st and 99th percentiles. Variable definitions are provided in Table 1. Industry fixed-effects (based on the Fama–French 48 industry classifications) and year fixed-effects are included in the model but are not reported. Coefficients of interest are in bold. ***, **, and * represent significance at the 1, 5, and 10 % levels, respectively

earnings growth are high. We present results from estimating Model (6) in Table 6. In Columns (1), (2), and (3), we present results where $Group_t$ is equal to $LowNumest_t$, $HighIdioVol_t$, and $HighLTG_t$, respectively. In Column (1), we examine whether short interest improves the informativeness of current returns with respect to future earnings to a greater extent when the information environment is weak, using the number of analysts following the firm to proxy for the strength of the information environment. We find that the coefficient on $LowNumest_t$*SI_t*X_{t3} is positive and significant, suggesting that short interest improves price efficiency to a greater extent when the information environment is weak.[22] In Column (2), we examine whether short interest increases the FERC to a greater extent when valuation uncertainty is high, using the firm's idiosyncratic volatility to proxy for

[22] This evidence provides additional support for the inference by Pownall and Simko (2005) that short sellers play a more important role in the capital markets when analyst following is low.

valuation uncertainty. Inconsistent with our expectations, we find that the coefficient on $HighIdioVol_t*SI_t*X_{t3}$ is insignificant. Thus we do not find evidence that short interest improves price efficiency to a greater extent when valuation uncertainty is high. Finally, in Column (3), we examine whether short interest allows current returns to reflect future earnings news to a greater extent when market expectations of long-term earnings growth are high, using analysts' long-term growth forecasts (LTG) to proxy for expectations about future earnings growth. We find that the coefficient on $HighLTG_t*SI_t*X_{t3}$ is positive and significant, confirming that short interest improves price efficiency to a greater extent when market expectations of long-term growth are more optimistic.

4.3 Robustness tests

4.3.1 Earnings persistence

When earnings persistence is high, an unexpected earnings shock will result in a greater revision to future earnings expectations and result in a stronger market reaction (Collins and Kothari 1989; Dhaliwal and Reynolds 1994). Thus earnings persistence is an important determinant of the returns-earnings relation. We measure earnings persistence, following Francis et al. (2004), as the slope coefficient, β_1, in the following model:

$$ROA_{t+1} = \beta_1 ROA_t + \varepsilon_t, \tag{7}$$

where ROA = Operating income after depreciation scaled by average total assets; and all subscripts are as previously defined.

We estimate Model (7) for each firm-year using a rolling 5-year window so we exclude earnings persistence from our main tests because it reduces our sample size (due to data availability). In untabulated analyses, we add earnings persistence and its interactions with the other variables from the basic FERC model to Model (4). We find that the coefficient on SI_t*X_{t3} remains positive and significant when we control for earnings persistence. We also find that the coefficient on earnings persistence interacted with future earnings is positive and significant.

4.3.2 Loss firms

Because 27.8 % of the observations in our sample report negative future income available to common shareholders before extraordinary items, we test whether loss firms are driving our results. Here, we remove all firms where $Loss_t$ is equal to one and reestimate Model (4). We find that the coefficient on SI_t*X_{t3} remains positive and significant.

4.3.3 Insider trading

Crawford et al. (2011) examine the impact of insider trading on the FERC. They argue that insider trades are informative because they reveal insiders' private

Table 6 Cross-sectional tests of the association between short interest and the FERC

$Group_t$=	$LowNumest_t$		$HighIdioVol_t$		$HighLTG_t$	
	(1)		(2)		(3)	
	Coef.	p value	Coef.	p value	Coef.	p value
Intercept	0.043***	0.0018	0.112***	<.0001	0.149***	<.0001
X_{t-1}	−0.364***	<.0001	−0.260***	<.0001	−0.474***	<.0001
X_t	1.802***	<.0001	1.669***	<.0001	1.656***	<.0001
X_{t3}	0.859***	<.0001	0.738***	<.0001	0.952***	<.0001
R_{t3}	−0.078***	<.0001	−0.073***	<.0001	−0.103***	<.0001
Si_t	−0.692***	<.0001	−0.342***	<.0001	−0.588***	<.0001
SI_t*X_{t-1}	−0.129	0.8028	−1.254**	0.0401	−1.996***	0.0033
SI_t*X_t	−2.770***	<.0001	−5.120***	<.0001	−1.782***	0.0082
SI_t*X_{t3}	0.565***	0.0055	0.980***	0.0001	−0.102	0.6682
SI_t*R_{t3}	−0.040	0.4356	−0.294***	<.0001	−0.185**	0.0233
$Group_t$	0.050***	<.0001	−0.010**	0.0230	0.001	0.9036
$Group_t$*X_{t-1}	0.015	0.6867	−0.130***	0.0005	−0.201***	<.0001
$Group_t$*X_t	−0.029	0.4588	0.155***	0.0002	0.336***	<.0001
$Group_t$*X_{t3}	−0.032**	0.0109	0.139***	<.0001	0.079***	<.0001
$Group_t$*R_{t3}	−0.008***	0.0083	−0.025***	<.0001	−0.002	0.5592
$Group_t$*SI_t	−0.160**	0.0466	−0.559***	<.0001	−0.165*	0.0575
$Group_t$*SI_t*X_{t-1}	0.866	0.3009	2.088***	0.0027	3.977***	<.0001
$Group_t$*SI_t*X_t	−1.647*	0.0656	1.470*	0.0809	−1.859**	0.0340
$Group_t$*SI_t*X_{t3}	**0.896*** **	**0.0009**	**−0.621**	**0.9839**	**1.843*** **	**<.0001**
$Group_t$*SI_t*R_{t3}	−0.312***	0.0001	0.303***	0.0001	0.011	0.9016
Inverse Mills ratio	Included		Included		Included	
Controls	Included		Included		Included	
Industry FE	Included		Included		Included	
Year FE	Included		Included		Included	
N	51,046		51,485		31,683	
Adjusted R^2	0.580		0.584		0.642	

This table presents the robust regression estimation results for Model (6) in which the dependent variable is current returns (R_t). In Columns (1), (2), and (3), Group = $LowNumest_t$, $HighIdioVol_t$, and $HighLTG_t$, respectively. p values are reported to the right of the coefficient estimates and are based on t statistics clustered by firm. All variables are truncated at the 1st and 99th percentiles. Variable definitions are provided in Table 1. Industry fixed-effects (based on the Fama–French 48 industry classifications) and year fixed-effects are included in the model but are not reported. Coefficients of interest are in bold. ***, **, and * represent significance at the 1, 5, and 10 % levels, respectively, using a two-tailed t test, except for on $Group_t$*SI_t*X_{t3}, where a directional prediction is made

information and beliefs. Consistent with their arguments, they find that current returns are more informative about future earnings when insider trading is greater. We add insider trading to Model (4) and interact it with X_{t-1}, X_t, X_{t3}, and R_{t3}. Because insider trading data are available for only a subsample of our observations,

we exclude insider trading from our main tests. We find that the coefficient on SI_t*X_{t3} remains positive and significant when we control for insider trading.

4.3.4 Risk free interest rates

Collins and Kothari (1989) suggest that the risk free rate is inversely related to the market's response to earnings news because higher current interest rates lead to higher expected future returns. Thus we add the risk free interest rate, defined as the average 1-month Treasury rate averaged over the firm's fiscal year, to Model (4) to determine whether our results are affected by the risk free rate. Because our interest rate measure is the same for all firms in a given year, we exclude year fixed-effects when estimating this model. We find that our inferences remain consistent in that the coefficient on SI_t*X_{t3} remains positive and significant.

5 Conclusion

We investigate whether short interest is associated with the extent to which current period returns reflect information in future period earnings, and we also investigate specific settings where short interest has the greatest impact on the pricing of future earnings. While prior research documents a negative association between short interest and short-term abnormal returns (Desai et al. 2002; Boehmer et al. 2008) and suggests that short sellers uncover bad news before it is publicly announced (Griffin 2004; Desai et al. 2006; Karpoff and Lou 2010; Drake et al. 2013), our study is the first to investigate the relation between short interest and future earnings response coefficients.

Our analyses yield several findings. First, we find that the ability of current returns to reflect future earnings news is increasing in short interest (and our results hold after controlling for other factors that are known to impact the FERC). Second, we find that our results are not driven by reverse causality—specifically, that short sellers are attracted to firms with higher FERCs—but that they trade on information that has not been previously impounded into stock prices. Finally, in cross-sectional tests, we find that higher short interest improves the informativeness of current returns about future earnings news when firm information environments are weaker and when market expectations of long-term earnings growth are high.

Our findings illuminate factors that improve the informativeness of current returns with respect to future earnings news and on specific settings where these factors are the most important (i.e., when markets are otherwise less efficient). We also add to prior evidence suggesting that short sellers play a key role in stock price discovery. That is, our evidence supports the argument that, because short sellers are sophisticated investors with strong incentives to accurately anticipate and trade on information in fundamental signals that has not yet been fully impounded into stock prices, they provide information about future earnings and improve the informativeness of stock prices. Our evidence does not support the alternative view that short sellers depress stock prices and move prices away from fundamental values. Furthermore, our results suggest that regulators should exercise caution as they

consider the practice of banning short selling because this could hurt financial markets by removing a means by which future earnings news gets impounded into stock prices. Our findings should also matter to academics, who investigate factors that affect the relation between returns and future earnings news, as well as those who investigate whether short sellers act as information intermediaries. Our findings should also be useful to investors interested in how short interest affects the information content of stock prices and, finally, to regulators interested understanding the benefits and costs of short selling.

Our study is subject to limitations that should be considered when interpreting the results. First, although we control for selection effects using the two-stage Heckman approach, we acknowledge that controlling for these effects is difficult in this setting and caution that our reported results may still be influenced by selection bias. Second, although we find no evidence that short sellers are attracted to firms with higher FERCs, we cannot rule out this possibility.

Acknowledgments We gratefully acknowledge the many helpful comments and suggestions offered by the editor, Patricia Dechow, and the anonymous reviewers. We also thank Hemang Desai, participants at the 2014 American Accounting Association Annual Meeting, and workshop participants at the University of Arkansas for helpful comments and suggestions. James Myers gratefully acknowledges financial support from the Ralph L. McQueen Chair, and Linda Myers gratefully acknowledges financial support from the Garrison/Wilson Chair, both at the University of Arkansas.

References

Asquith, P., Pathak, P. A., & Ritter, J. R. (2005). Short interest, institutional ownership, and stock returns. *Journal of Financial Economics, 78*, 243–276.

Ayers, B. C., & Freeman, R. N. (2003). Evidence that analyst following and institutional ownership accelerate the pricing of future earnings. *Review of Accounting Studies, 8*, 47–67.

Ball, R., & Brown, P. (1968). An empirical evaluation of accounting income numbers. *Journal of Accounting Research, 6*(2), 159–178.

Barniv, R., Hope, O., Myring, M., & Thomas, W. (2009). Do analysts practice what they preach and should investors listen? Effects of recent regulations. *The Accounting Review, 84*(4), 1015–1039.

Beaver, W., Lambert, R., & Morse, D. (1980). The information content of security prices. *Journal of Accounting and Economics, 2*, 3–28.

Beber, A., & Pagano, B. (2013). Short selling bans around the world: Evidence from the 2007–09 crisis. *The Journal of Finance, 68*(1), 343–381.

Bhushan, R. (1989). Firm characteristics and analyst following. *Journal of Accounting and Economics, 11*, 255–274.

Boehmer, E., Huszar, Z. R., & Jordan, B. D. (2010). The good news in short interest. *Journal of Financial Economics, 96*, 80–97.

Boehmer, E., Jones, C. M., & Zhang, X. (2008). Which shorts are informed? *The Journal of Finance, 63*(2), 491–527.

Carhart, M. M. (1997). On persistence in mutual fund performance. *The Journal of Finance, 52*(1), 57–82.

Chan, L., Karcecki, J., & Lakonishok, J. (2003). The level and persistence of growth rates. *The Journal of Finance, 58*(2), 643–684.

Choi, J., Myers, L. A., Zang, Y., & Ziebart, D. A. (2011). Do management EPS forecasts allow returns to reflect future earnings? Implications for the continuation of management's quarterly earnings guidance. *Review of Accounting Studies, 16*, 143–182.

Christophe, S. E., Ferri, M. G., & Angel, J. J. (2004). Short-selling prior to earnings announcements. *The Journal of Finance, 59*(4), 1845–1875.

Collins, D. W., & Kothari, S. P. (1989). An analysis of intertemporal and cross-sectional determinants of earnings response coefficients. *Journal of Accounting and Economics, 11*, 143–181.
Collins, D. W., Kothari, S. P., & Rayburn, J. D. (1987). Firm size and the information content of prices with respect to earnings. *Journal of Accounting and Economics, 9*, 111–138.
Collins, D. W., Kothari, S. P., Shanken, J., & Sloan, R. (1994). The lack of timeliness and noise as explanations for the low contemporaneous returns-earnings association. *Journal of Accounting and Economics, 18*, 289–324.
Collins, D. W., Pincus, M., & Xie, H. (1999). Equity valuation and negative earnings: The role of book value of equity. *The Accounting Review, 74*(1), 29–61.
Core, J. E., & Schrand, C. M. (1999). The effect of accounting-based debt covenants on equity valuation. *Journal of Accounting and Economics, 27*(1), 1–34.
Crawford, S., Park, D., & Roulstone, D. (2011). *Insider trading and the incorporation of future earnings news into stock prices*. Working paper, Rice University and The Ohio State University.
Da, Z., & Warachka, M. (2011). The disparity between long-term and short-term forecasted earnings growth. *Journal of Financial Economics, 100*, 424–442.
De Bondt, W., & Thaler, R. (1990). Do security analysts overreact? *The American Economic Review, 80*(2), 52–57.
Dechow, P. M., Hutton, A. P., Meulbroek, L., & Sloan, R. G. (2001). Short-sellers, fundamental analysis, and stock returns. *Journal of Financial Economics, 61*, 77–106.
Dechow, P. M., Hutton, A. P., & Sloan, R. G. (2010). The relation between analysts' forecasts of long-term earnings growth and stock price performance following equity offerings. *Contemporary Accounting Research, 17*(1), 1–32.
Desai, H., Krishnamurthy, S., & Venkataraman, K. (2006). Do short sellers target firms with poor earnings quality? Evidence from earnings restatements. *Review of Accounting Studies, 11*, 71–90.
Desai, H., Ramesh, K., Thiagarajan, S. R., & Balachardran, B. V. (2002). An investigation of the informational role of short interest in the Nasdaq market. *The Journal of Finance, 57*(5), 2263–2287.
Dhaliwal, D. S., Lee, K. J., & Fargher, N. L. (1991). The association between unexpected earnings and abnormal security returns in the presence of financial leverage. *Contemporary Accounting Research, 8*(1), 20–41.
Dhaliwal, D. S., & Reynolds, S. S. (1994). The effect of the default risk of debt on the earnings response coefficient. *The Accounting Review, 69*(2), 412–419.
Diamond, D. W., & Verrecchia, R. E. (1987). Constraints on short-selling and asset price adjustment to private information. *Journal of Financial Economics, 18*(2), 277–311.
Diether, K. B., & Werner, I. M. (2011). *When constraints bind*. Working paper, Dartmouth College and The Ohio State University.
Drake, M. S., Myers, L. A., Scholz, S., & Sharp, N. Y. (2013). *Short selling around accounting restatements: When do bears pounce?* Working paper, Brigham Young University, University of Arkansas, University of Kansas, and Texas A&M University.
Drake, M. S., Rees, L., & Swanson, E. P. (2011). Should investors follow the prophets of the bears? Evidence on the use of public information by analysts and short sellers. *The Accounting Review, 86*(1), 101–130.
Easterwood, J., & Nutt, S. (1999). Inefficiency in analysts' earnings forecasts: Systematic misreaction or systematic optimism? *The Journal of Finance, 54*(5), 1777–1797.
Easton, P., Taylor, G., Shroff, P., & Sougiannis, T. (2002). Using forecasts of earnings to simultaneously estimate growth and the rate of return on equity investment. *Journal of Accounting Research, 40*(3), 657–676.
Efendi, J., & Swanson, E. P. (2009). *Short seller trading in companies with accounting irregularities*. Working paper, University of Texas at Arlington and Texas A&M University.
Ettredge, M. L., Kwon, S. Y., Smith, D. B., & Zarowin, P. A. (2005). The impact of SFAS No. 131 business segment data on the market's ability to anticipate future earnings. *The Accounting Review, 80*(3), 773–804.
Francis, J., LaFond, R., & Olsson, P. M. (2004). Costs of equity and earnings attributes. *The Accounting Review, 79*(4), 967–1010.
Francis, J., Venkatachalam, M., & Zhang, Y. (2008). *Do short sellers convey information about changes in fundamentals?* Working paper, Duke University.
Gelb, D. S., & Zarowin, P. (2002). Corporate disclosure quality and the informativeness of stock prices. *Review of Accounting Studies, 7*, 33–52.

Gerard, B., & Nanda, V. (1993). Trading and manipulation around seasoned equity offerings. *The Journal of Finance, 48*, 213–245.
Givoly, D., & Lakonishok, J. (1979). The information content of financial analysts' forecasts of earnings. *Journal of Accounting and Economics, 1*(3), 168–185.
Gleason, C. A., & Lee, C. M. C. (2003). Analyst forecast revisions and market price discovery. *The Accounting Review, 78*(1), 193–225.
Griffin, P. (2004). A league of their own? Financial analysts' responses to restatements and corrective disclosures. *Journal of Accounting, Auditing and Finance, 18*, 479–518.
Grossman, S. T., & Stiglitz, J. E. (1980). On the impossibility of informationally efficient markets. *The American Economic Review, 70*(3), 393–408.
Henry, T. R., Kisgen, D. J., & Wu, J. (2013). *Do equity short sellers anticipate bond rating downgrades?* Working paper, Miami, University, Boston College, and University of Georgia.
Henry, T. R., & Koski, J. L. (2010). Short selling around seasoned equity offerings. *Review of Financial Studies, 23*, 4389–4418.
Hirshleifer, D., Teoh, S. H., & Yu, J. J. (2011). Short arbitrage, return asymmetry, and the accrual anomaly. *Review of Financial Studies, 24*(7), 2429–2461.
Hosmer, D. W., & Lemeshow, S. (2005). Model-building strategies and methods for logistic regression. In W. A. Shewhart, & S. S. Wilks (Eds.), *Applied logistic regression* (pp. 91–142). Danvers, MA: Wiley.
Jaccard, J., & Turrisi, R. (2003). "Interaction effects in multiple regressions," Sage University Papers Series on Quantitative Applications in the Social Sciences, no. 07-072, 2nd ed., Thousand Oaks, CA.
Jiang, G., Lee, C. M. C., & Zhang, Y. (2005). Information uncertainty and expected returns. *Review of Accounting Studies, 10*, 185–221.
Karpoff, J. M., & Lou, X. (2010). Short sellers and financial misconduct. *The Journal of Finance, 65*(5), 1879–1913.
Kothari, S. P. (2001). Capital markets research in accounting. *Journal of Accounting and Economics, 31*, 105–231.
Kumar, A. (2009). Hard-to-value stocks, behavioral biases, and informed trading. *Journal of Financial and Quantitative Analysis, 44*(6), 1375–1401.
La Porta, R. (1996). Expectations and the cross-section of stock returns. *The Journal of Finance, 51*(5), 1715–1742.
Lang, M., & Lundholm, R. (1993). Cross-sectional determinants of analyst ratings of corporate disclosures. *Journal of Accounting Research, 31*(2), 246–271.
Lang, M. H., & Lundholm, R. J. (1996). Corporate disclosure policy and analyst behavior. *The Accounting Review, 71*(4), 467–492.
Lennox, C. S., Francis, J. R., & Wang, Z. (2012). Selection models in accounting research. *The Accounting Review, 87*(2), 589–616.
Leone, A. J., Minutti-Meza, M., & Wasley, C. E. (2014). *Influential observations and inference in accounting research*. Working paper, University of Miami and University of Rochester.
Lundholm, R., & Myers, L. A. (2002). Bringing the future forward: The effect of disclosure on the returns-earnings relation. *Journal of Accounting Research, 40*(3), 809–839.
Lys, T., & Shon, S. (1990). The association between revisions of financial analysts' earnings forecasts and security-price changes. *Journal of Accounting and Economics, 13*, 341–363.
Mashruwala, C., Rajgopal, S., & Shevlin, Y. (2006). Why is the accrual anomaly not arbitraged away? The role of idiosyncratic risk and transactions costs. *Journal of Accounting and Economics, 42*, 3–33.
Nagel, S. (2005). Short sales, institutional investors and the cross-section of stock returns. *Journal of Financial Economics, 78*(2), 277–309.
Orpurt, S., & Zang, Y. (2009). Do direct cash flow disclosures help predict future operating cash flows and earnings? *The Accounting Review, 84*(3), 893–935.
Pae, J., Thornton, D. B., & Welker, M. (2010). The link between earnings conservatism and the price-to-book ratio. *Contemporary Accounting Research, 22*(3), 693–717.
Piotroski, J. D., & Roulstone, D. T. (2004). The influence of analysts, institutional investors, and insiders on the incorporation of market, industry, and firm-specific information into stock prices. *The Accounting Review, 79*(4), 1119–1151.
Pownall, G., & Simko, P. J. (2005). The information intermediary role of short sellers. *The Accounting Review, 80*(3), 941–966.

Roulstone, D. T. (2003). Analyst following and market liquidity. *Contemporary Accounting Research, 20*(3), 552–578.

Saffi, P. A. C., & Sigurdsson, K. (2010). Price efficiency and short selling. *The Review of Financial Studies, 24*(3), 821–852.

Strong, N., & Walker, M. (1993). The explanatory power of earnings for stock returns. *The Accounting Review, 68*(2), 385–399.

Tucker, J. W., & Zarowin, P. A. (2006). Does income smoothing improve earnings informativeness? *The Accounting Review, 81*(1), 251–270.