The influence of short sellers on negative press coverage and price discovery

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Abstract

In this paper we empirically address two questions: (1) Do short sellers influence the extent to which negative news is reported by the business press?; and (2) Do reduced short selling constraints bring more arbitrage capital and informed trading pressure to bear on negative business press coverage, increasing the speed and intensity with which negative news reports are impounded into stock price.? Exploiting the randomized Regulation SHO experiment to identify effects of short-sale constraints, we find that following reduction in short selling costs the sentiment of pilot firms' press coverage tilts significantly more negative and the probability of their receiving negative news coverage increases. This result holds for media-initiated articles, but not for firm-initiated press releases, and is more pronounced for more opaque firms where short sellers are likely to have greater scope for relative information advantage. Consistent with short-sale constraints limiting arbitrage activities, we find that following relaxation of short selling constraints stock returns become more sensitive to negative news reports, more arbitrage capital is allocated to news sentiment-based trading strategies and such trading strategies earn lower abnormal returns.

Keywords: Short Selling, News Media, Negative News, Disclosure

Introduction

In this paper we investigate whether short sellers influence the extent of a firm's negative press coverage and stock price discovery process. Our study contributes to the large body of research examining how the information environment of publicly traded firms is shaped by the incentives of firm managers and other capital market participants operating within the confines of existing securities regulation and other important institutional features. In this regard, a large body of research focuses on the incentives of firm managers to disclose, disseminate and strategically manage information about firm fundamentals (e.g., Miller and Skinner, 2015; Beyer et al., 2010), the role of sell-side analysts as key information intermediaries in capital markets (e.g., Bradshaw, et al., 2017), the influence of institutional ownership on firm transparency and information production (e.g., Boone and White, 2015), and the interaction between disclosure regulation and firms' reporting incentives (e.g., Luez and Wysocki, 2016).

In addition, an evolving literature examines the role of the business press as an important information intermediary in financial markets (e.g., Miller and Skinner, 2015; Tetlock, 2014; Bushee, 2010). Much of the research to date takes the media's coverage decisions as given and investigates market consequences of observed coverage.[1] In contrast, there is relatively less research examining how firms' press coverage is influenced by interactions between the media and other players in financial markets. While the media's interactions with company management and financial analysts have received some recognition (e.g., Call, et al., 2018), we extend the scope of the literature by exploring the possibility that informed short sellers interact with the business press to disseminate negative news and thereby shape the media coverage of firms whose stock

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[1] A recent exception is Niessner and So (2018) who provide evidence that competition for the public's attention creates incentives for the financial press to tilt coverage selection toward negative news. We complement and extend Niessner and So (2018) by providing evidence that short sellers influence the flow of negative media coverage. See also Gentzkow and Shapiro (2008).

they short sell. Specifically we hypothesize that a relaxation of short selling constraints amplifies short selling activity which (1) increases the extent to which negative news about firms is reported by the business press; and (2) increases the flow of arbitrage capital to news sentiment-based trading strategies, and increases the speed and intensity with which negative news reports are impounded into stock price.

Our first hypothesis builds on two aspects of short selling that have received empirical support in the previous literature. The first is that short sellers are informed traders. The finance literature provides strong evidence that this is the case, documenting that when short interest or volume is high, future returns are predictably low (e.g., Senchack and Starks, 1993; Asquith, et al., 2005; Diether, et al., 2008; Boehmer et al., 2008). Second, the media can serve as an important dissemination mechanism for informed short sellers to drive their negative information into prices. The idea presumes a sequencing in which traders gather and analyze publicly available information, sell short when they believe price exceeds fundamental value by enough to dominate trading costs, and then communicate their conclusions to the media with the hope of generating a price decline that allows them to cover at a profit.[2] Fox et al. (2010) provide evidence consistent with this sequencing, finding that abnormally high levels of short selling in a firm's stock is followed by significant elevation in the level of negative media reports about the firm. We build on this literature by considering how shifts in securities regulation can induce changes in media coverage by changing the incentives of short sellers.

Our strategy for empirically identifying consequences of interactions between short sellers and the media is motivated by extensive evidence that short selling constraints are an important

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[2] Informed short sellers can also earn profits from strategies that do not rely on disseminating news through the media. We discuss these possibilities in section 2.1 below. To the extent that such alternatives dominate the short selling landscape, we would not expect to find a strong relation between short selling constraints and negative media coverage.

limit to arbitrage that inhibits investors from profitably short selling stocks they believe are overpriced.[3] Thus, following a relaxation of short selling constraints we expect to see an increase in negative media coverage as traders react to reduced trading frictions by more aggressively seeking information, taking short positions and disseminating negative information.

To capture changes in short selling constraints, we exploit a natural experiment, the Rule 202T pilot program of Regulation SHO. Under the Rule 202T pilot program stocks in the Russell 3000 index were ranked by trading volume within each exchange and every third one was designated as a pilot stock. From May 2, 2005 to August 6, 2007, pilot stocks were exempted from short sale price tests. With respect to the pilot program, Alexander and Peterson (2008) find that order execution and market quality improved for the pilot stocks during the pilot program. Diether et al. (2009) and SEC (2007) show that pilot stocks listed on both NYSE and NASDAQ experienced a significant increase in short-sale trades and in the ratio of short sales to share volume during the term of the pilot program.[4] Further, Diether et al. (2009) shows that NYSE listed pilot stocks experienced a higher level of order-splitting, suggesting that short sellers implemented more active trading strategies. Building on this evidence, we believe the Rule 202T pilot program provides a useful setting to isolate effects of short-selling constraints on negative media coverage.

To measure media coverage, we use data from RavenPack News Analytics, which covers all news disseminated via Dow Jones Newswires and the Wall Street Journal. RavenPack reports news sentiment scores that reflect assessments of the tone in a given article (i.e., positive versus negative news), as well as the strength of the positive or negative news reflected in the article. RavenPack also distinguishes between news initiated by the firm and news initiated by the media,

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[3] See for example Chu et al. (2019), Drechsler and Drechsler (2014), Israel and Moskowitz (2013), Hirshleifer et al. (2011), Asquith et al., (2005), Nagel (2005), Jones and Lamont (2002) and Geczy et al. (2002), among others.
[4] Grullon et al. (2015) also provide evidence of an increase in short selling activity associated with the Rule 202T pilot program.

a feature which we use to distinguish media activities from firms' voluntary disclosure decisions. We construct our media sentiment variable quarterly by averaging the RavenPack media sentiment over all articles during the quarter that reflect novel news about a firm.

We adopt a difference-in-difference design, designating as treatment firms those pilot firms exempted from short sale price tests under Regulation SHO, and all other firms as control firms. Consistent with our hypothesis, we find that following implementation of Regulation SHO the overall sentiment of media coverage tilts significantly more negative and the probability of receiving negative news coverage increases for pilot firms relative to controls. We further find that differences in negative press coverage between pilot and control groups disappear after the end of the experiment when all firms face identical short selling rules.

We also perform cross-sectional analyses examining the proposition that the incentives of short sellers to disseminate negative news are greater in settings that provide them with greater opportunities for a profitable information advantage. We posit that more opaque firms allow greater scope for information advantage, and hypothesize that the sensitivity of negative media coverage to reduced short selling constraints will be relatively higher for pilot firms with weaker information environments. We find that the increase in negative media tilt is significantly greater for pilot firms with lower media coverage intensity (number of articles), lower institutional ownership levels and higher bid-ask spreads. In related work, Zhao (2019) finds that activist short sellers are more likely to target opaque firms than non-opaque firms. While we do not separately consider activist short-sellers, it is quite plausible that such short sellers actively reach out to journalists as part of their negative information dissemination strategy.[5]

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[5] On January 9, 2019, The Stigler Center/CBR podcast Capitalisn't released an episode entitled, The Financial Assassin, which interviews renowned short seller Fahmi Quadir. This provides an interesting perspective on the role of the media in short selling. See http://review.chicagobooth.edu/finance/2019/article/capitalisn-t-financial-assassin .

We have not to this point distinguished articles initiated by the media from firm-initiated press releases. This distinction is potentially important as firm managers' may disclose strategically in the face of greater short selling pressure. There is mixed evidence to date on how short selling costs influence firms' voluntary disclosures. Cheng et al. (2014) finds that managers react to greater short selling pressure by releasing more good news forecasts, Clinch et al. (2016) finds that firms increase bad news disclosure with no effect on good news, and Li and Zhang (2015) find that managers do not change the likelihood of issuing good versus bad news forecasts.[6] Extending this literature by examining firm press releases, we find no evidence that firms' press release sentiment responds to lower short selling costs, in contrast to the sentiment of media-initiated articles which tilts significantly more negative. However, we do find that pilot firms reduce the number of press releases, while the number of media-initiated articles increases.

While our previous analyses document that media coverage tilts more negative following a relaxation in short selling constraints, there is also likely to be a change in the relation between negative news and stock price formation. We hypothesize that lower short selling costs will bring more arbitrage capital and informed trading pressure to bear on negative news, and thereby increase the speed and intensity with which negative news reports are impounded into stock price. Previous research provides empirical evidence that short selling enhances the price discovery process (e.g., Boehmer and Wu, 2013; Saffi and Sigurdsson, 2011).

Directly pertinent to our study, Chu et al. (2019) use the pilot program of Regulation SHO to provide evidence that well-known asset pricing anomalies weaken substantially following a relaxation of short selling constraints. They document that the effect comes only from the short legs of the anomaly portfolios. Further, Engelberg et al. (2012) find that a portion of short sellers'

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[6] In related research, Fang et al. (2016) finds evidence consistent with lower short selling costs being associated with a higher probability of detecting fraud and a reduction in earnings management.

trading advantage comes from their ability to analyze negative news coverage. Together with our finding that a reduction in short-selling constraints increases the flow of negative media coverage to the market, these studies suggest that increased short selling both before and after negative news releases can accelerate price discovery We extend this literature by exploring how a reduction in short selling constraints influences arbitrage activity and the price discovery process around negative business press reports.

Focusing first on the intensity with which negative news is impounded into stock prices, we find that the sensitivity of pilot firm stock returns to negative news coverage increases significantly relative to non-pilot firms following implementation of SHO. We next examine how short selling costs influence the flow of arbitrage capital to news sentiment-based trading strategies. Following Hanson and Sunderam (2014) and Guest et al. (2017), we use variation in monthly short-interest to estimate the responsiveness of short interest levels to negative news sentiment. Consistent with more arbitrage capital being directed to news sentiment-based trading strategies, we find that short interest is significantly more sensitive to extreme negative news sentiment for pilot firms post SHO-implementation. Further, a trading strategy based on news sentiment yields smaller abnormal returns for pilot firms during the experiment relative to the control group.

Our study makes several substantive contributions to the literature. Exploiting exogenous variation in short selling constraints deriving from the Rule 202T pilot program of Regulation SHO, we provide evidence that short sellers influence both business press coverage of publicly traded firms and the impact of negative news coverage on stock price discovery. In this regard, we contribute to the call by Miller and Skinner (2015) for research that develops a more complete theory of the role of the media in financial markets, including consideration of inputs such as the

media's interaction with other players in financial markets (see also Call et al., 2019). While many papers independently examine the role of short sellers as informed traders and the role of the media as an important information intermediary, we are the first to explore the interaction between short selling frictions and the actual flow of negative information to the market via the financial press. Our evidence suggests that the media serves as an important dissemination mechanism for informed short sellers to drive their negative beliefs into prices, and that their incentives to use this mechanism depend on short selling constraints. Our finding that media coverage endogenously emerges as a function of short selling constraints complements Niessner and So (2018) who provide evidence that competition for the investing public's attention creates incentives for the financial press to tilt coverage selection toward negative news.

Our analyses also complement and extend the literature examining the influence of short selling on the price discovery process. (e.g., Chu et al., 2019; Boehmer and Wu, 2013; Saffi and Sigurdsson, 2011), as well as research examining associations between the business press and the information advantage of short sellers (e.g., Engelberg et al., 2012; Fox et al., 2010). Our results suggest that lower short selling costs are associated with higher sensitivity of stock returns to negative media coverage, and with a greater flow of arbitrage capital and lower abnormal returns to news sentiment-based trading strategies. Finally, our paper extends the accounting literature on short selling and voluntary disclosure (e.g., Cheng et al., 2014; Li and Zhang, 2015; Clinch et al., 2016) by examining relations between short selling constraints and firms press release decisions. After a drop in short selling costs, we find no change in the sentiment of firms' press releases, but do observe a significant reduction in the number of press releases issued.

The reminder of the paper is organized as follows. Section 2 develops our conceptual framework in the context of the related literature. Section 3 describes our measures of short selling

constraints and media sentiment. Section 4 discusses our analyses of relations between short

selling constraints and media tilt. Section 5 presents results of our analysis of how short selling

costs impact relations between negative news and speed of price adjustments. Section 6 provides

robustness analysis and section 7 summarizes and concludes the paper.

2. Related Literature and Conceptual Framework

A large literature examines the role of the business press as an important information

intermediary in capital markets. An independent literature examines informed short selling and

considers how short selling constraints impact informed trading behavior, price efficiency, and the

behavior of firms' managers. In this paper we synthesize and extend these literatures by first

exploring how interactions between short sellers and the business press influence firms' negative

media coverage of firms and managers' press release strategies. Section 2.1 discusses the

motivation for our hypotheses on the role of short selling in shaping firms' media coverage.

We also consider the impact of short selling constraints on relations between negative

media coverage and both the allocation of arbitrage capital and stock price discovery. Section 2.2

discusses the motivation for our hypothesis that a reduction in short selling constraints will

increase the flow of arbitrage capital to news sentiment-based trading strategies, and increase the

speed and intensity with which negative news reports are impounded into stock price.

2.1. Media Coverage of Firms and Short Selling

An evolving literature examines the role of the business press in collecting and

disseminating value-relevant information to capital market participants (e.g., Miller and Skinner,

2015; Tetlock, 2014). Tetlock, et al. (2008) and Engelberg (2008) show that the qualitative content

of information contained in news stories can predict both earnings surprises and short-term returns.

Engelberg and Parsons (2011) provide evidence that the media has a causal impact on investor

behavior by comparing the behaviors of investors with access to different media coverage of the same information event. Dougal et al., (2012) find that specific financial columnists have a causal effect on short-term aggregate stock market prices. Bushee et al. (2010) document that press coverage reduces bid-ask spreads and increases depth around earnings announcements, where Fang and Peress (2009) find that stocks with low media coverage have higher returns than stocks with high coverage. While this literature generally takes media coverage as given, we allow for the possibility media coverage is endogenously determined informed short sellers.

Our hypothesis builds on the premise that short selling activity is characterized by informed short sellers taking short positions in overpriced stocks and then disseminating their information via various information channels, including the media. There is strong evidence that short sellers are informed traders. A number of papers document that when short interest or volume is high, future returns are low (e.g., Senchack and Starks, 1993; Asquith, et al., 2005; Diether, et al., 2008; Kelly and Tetlock, 2017). For example, Boehmer et al. (2008) find that heavily shorted stocks underperform lightly shorted stocks, while others show that relaxation of shorting constraints mitigates overvaluation, consistent with short sellers moving prices toward fundamentals (e.g., Lamont and Thaler; 2003; Jones and Lamont, 2002).

While this evidence is consistent with informed short sellers, it does not speak to the source of their information advantage. For example, traders can sell short in anticipation of future negative announcements by firms or other independent parties (e.g., Christophe et al., 2004; Christophe et al., 2010; Karpoff and Lou, 2010; Boehmer et al., 2018). There is evidence that short sellers' trading advantage comes from their superior ability to extract information, especially negative information, from published media reports (Engelberg et al., 2012).[7] Also, Zhao (2019) documents

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[7] For more discussion of the view that public news events present profitable trading opportunities for skilled information processors see Kandel and Pearson (1995) and Engle et al. (2012).

that activist short-sellers exploit corporate opacity to conduct informative rather than manipulative short attacks, finding that opaque activist targets have more negative short-term returns without subsequent reversals. While we do not separately consider activist short-sellers, it is quite plausible that such short sellers actively reach out to journalists as part of their negative information dissemination strategy.

Directly pertinent to our study, Fox et al. (2010) provide evidence consistent with traders gathering and analyzing publicly available information, selling short when they believe a stock is overpriced, and then transmitting their conclusions to the media with the hope of generating a price decline that allows them to cover at a profit. Specifically, Fox et al. (2010) find that abnormally high levels of short selling in a firm's stock is followed by significant elevation in the level of negative media reports about the firm.

Building on Fox et al. (2010), we hypothesize that the media serves as an important dissemination mechanism for informed short sellers and that a relaxation of short selling constraints will increase the tendency of informed short sellers to disseminate negative news about firms via the business press. To the extent that the prevalence of short selling activity relying on the media to disseminate negative news is a minor aspect of the overall short selling landscape, we would not expect to find a strong relation between short selling constraints and media coverage. It is also an open question as to whether short sellers are generally viewed as credible sources of information by journalists.[8]

2.2. Short Selling Constraints and Price Discovery around Negative News Coverage

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[8] For example, in the context of journalists' investigating corporate fraud, Call et al. (2018) quote a journalist cautioning that "You have to be skeptical of everyone, because there's more than enough people that are short selling that will tell you everyone they're shorting is a fraud."

Short sale constraints are generally considered a significant limit to arbitrage (e.g., Jones and Lamont, 2002; Lamont and Thaler, 2003). Theories show that short-sale constraints decrease the efficiency of stock prices by preventing traders with heterogeneous from revealing their beliefs through trading (Miller, 1977; Diamond and Verrecchia, 1987; Duffie et al., 2002). A number of papers document that short sellers have value-relevant information and suggest that their trading helps correct overvaluation.[9] Several recent papers explicitly investigate the impact of short selling on the stock price discovery process (e.g., Chu et al., 2019; Boehmer and Wu, 2013; Saffi and Sigurdsson, 2011; Chang et al., 2007). Germane to our study, Chu et al. (2019) examine the effects of short-selling related limits to arbitrage on 11 well-known asset pricing anomalies. Using the pilot program of Regulation SHO, Chu et al. (2019) find that the anomalies became significantly weaker on portfolios constructed with pilot stocks during the pilot period. Further, the effect comes only from the short legs of the anomaly portfolios.

While our earlier analyses considered the impact of short selling constraints on negative media coverage, we next examine the impact of short selling constraints on the flow of arbitrage capital and stock price discovery surrounding negative news coverage. We note that such effects can be driven by short selling activities that either precede or follow the release of negative news stories. On the one hand, reduced trading frictions can heighten incentives to aggressively seek information advantage in anticipation of upcoming negative news coverage. In this case, anticipated negative news announcements can result from either sellers feeding information to the media (Fox et al., 2010), or with short sellers anticipating negative announcements by firms or other independent parties (e.g., Christophe et al., 2004; Christophe et al., 2010; Karpoff and Lou, 2010; Boehmer et al., 2018). On the other hand, such effects can derive from short sellers more

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[9] These papers include Dechow et al. (2001), Desai et al. (2002), Asquith et al. (2005), Christophe et al. (2004), Boehmer et al. (2008) and Diether et al. (2008), among others.

aggressively extracting information from publicly released news about negative corporate events. In this regard, Engelberg et al. (2012) find that a portion of short sellers' trading advantage comes from their superior abilities in extracting information from publicly released news stories. While news events occur on only 22% of the days in their sample, these trading days account for over 45% of the total profitability from short selling. While, as in prior literature, they find that abnormal short selling leads to lower future returns, this effect is concentrated around news events where predictability for future returns more than doubles on news days and quadruples on days with negative news.

We do not attempt to distinguish these different possibilities, but rather examine whether the combined effects of any and all changes in short selling behavior increase the flow of arbitrage capital to news sentiment-based trading strategies and increase the speed and intensity with which negative news is impounded into prices.

3. Measuring Short Selling Constraints and Media Sentiment

As discussed earlier, we capture changes in short selling constraints using the natural experiment defined in the Rule 202T pilot program of Regulation SHO. We adopt a difference-in-difference design with treatment firms designated as all pilot firms in the Russell 3000 index exempted from short sale price tests under Regulation SHO, and all remaining firms are designated as control firms (or non-pilot firms). A similar difference-in-difference specification has been used in a number of recent papers using the pilot program to examine implications of short selling constraints.

For example, Chu et al. (2019) find that 11 well-known asset pricing anomalies became significantly weaker on portfolios constructed with pilot stocks during the pilot period and that pilot short-leg portfolios reflect more intensive short selling once short-sale constraints are relaxed;

Diether et al. (2009) find that the pilot program increases short-selling activity for pilot firms and pilot stocks experience a small increase in spreads and intraday volatility; Grullon et al. (2015) find that the pilot program leads to an increase in short-selling activity and a decline in prices for pilot stocks, especially for small firms who also reduce equity issues and investment; Li and Zhang (2015) show that the pilot program increases price sensitivity to bad news, making managers more likely to reduce the precision of bad news forecasts; and Fang et al. (2016) show that the pressure of short-selling on stock prices due to the pilot program curbs managers' willingness to manipulate earnings. We are the first to use the pilot program to examine interactions between short selling and negative news coverage.

Our news coverage data is from RavenPack News Analytics, a daily dataset that assigns a sentiment scores to business news stories using a range of textual analysis techniques. RavenPack's Composite Sentiment Score (CSS) reflects an assessment of the tone of the news in a given article (i.e., positive or negative news) as well as the strength of the news the article contains. Following prior studies (e.g. Bushman et al., 2016), we eliminate news flashes (articles composed of only a headline and no body text), hot-news-flashes and tabular-material (news article composed of a headline and mostly tabular data). We further restrict our sample to full-size articles with a relevance score of 75 and above. A relevance score is assigned by RavenPack to indicate how strongly a firm features in the underlying news story. The scores range from 0 (low relevance) to 100 (high relevance). Scores above 75 are considered significantly relevant for a firm. Finally, we focus on articles most likely to convey novel news about a firm by only utilizing articles with Event Novelty Scores (ENS) of 100. ENS indicates how novel a news story is within a 24-hour time window by assigning a score of 100 to articles covering a news event about a firm for the first time, where subsequent articles about the same event receive lower scores.

To examine relations between short selling constraints and news sentiment we operationalize media sentiment by computing the average of RavenPack's Composite Sentiment Score (CSS) over the quarter ending one day before the earnings announcement date.[10] CSS scores range between 0 to 100, with a score above 50 indicating positive news; a score equal to 50, neutral news; and a score below 50, negative news.[11]

Table 1 summarizes the sample selection process. We start with 62,888 observations with accounting, equity and analyst data from 2000 to 2010. Next, we merge the dataset with RavenPack resulting in a sample with 45,487 observations. After limiting our sample period to the years 2003 to 2009, we are left with 43,513 observations. Similar to Fang et al. (2016), we eliminate firms from financial services (SIC 6000-6999) and utilities (SIC 4900-4949), resulting in 38,677 observations from 2003 to 2009. In our main analysis we focus on period January 2003 through July 2007, yielding 25,743 observations. We designate the period January 2003 through April 2005 as the pre-pilot period, and May 2005 through July of 2007 as the pilot program. We also examine differences between pilot firms and controls in the period after the pilot program ends, designating the post-pilot period as August 2007 to October 2009. The final sample contains 2,306 firms composed of 749 treated firms and 1577 control firms. Table 1 shows that our final sample maintains the same proportion of treatment and control firms as that of the overall experiment.

Table 2 presents descriptive statistics on our media sentiment measures. The variable *Tone* reflects the overall RavenPack media sentiment score. We also disaggregate *Tone* into media-initiated articles and firm-initiated press releases which are designated as *Financial Media Tone*

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[10] Niessner and So (2017) also exclude earnings announcement dates when computing their coverage measures, using the 50 trading days ending 5 days before firms' quarterly earnings announcements. Our results are robust to including the earnings announcement date.

[11] See Appendix A for a more detailed description of RavenPack's CSS measure. All variables are defined in the Appendix A and we annually winsorize all continuous variables at the 1% and 99% levels across quarters.

and *Press Release Tone*, respectively. In table 2, panel A we report descriptive statistics for the year 2003, which predate the announcement of the SHO experiment. Table 2, panel A reports that in 2003 there are no significant differences in media sentiment between pilot firms and controls. *Tone* has a mean value for pilot (control firm of 50.49 (50.47), which indicates a slightly positive tilt (recall that 50 reflects neutral sentiment). When we split sentiment into *Financial Media Tone* and *Press Release Tone* measures, table 2, panel A shows that pilot (control) firm press releases have mean sentiment of 51.51 (51.56), indicating a positive tilt, while financial media exhibits a slightly negative tilt with mean sentiment of 49.44 (49.49). For comprehensiveness, in Table 2, panel B we report descriptive statistics for the entire sample period, reporting statistics comparable to those reported in panel A.

4. Does a Relaxation of Short Selling Constraints Increase Negative Media Coverage

In this section we use a difference-in-difference design to empirically examine the hypothesis that a relaxation of short selling constraints increases the extent of negative news coverage for pilot firms relative to control firms. Section 4.1 describes our main empirical specification. Section 4.2 reports our empirical results on relations between short selling constraints and negative media tilt, including cross-sectional analyses examining the proposition that the increase in negative coverage will be greater for firms with weaker information environments. Finally, in Section 4.3 we report results from separately examining media-initiated coverage and firm-initiated press releases.

4.1 The main empirical specification

Our primary empirical specification uses the following difference-in-difference design:

$$Tone_{it} = \alpha_0 + \alpha_1 * I(Pilot) * I(During) + \alpha_2 * I(Pilot) + \alpha_3 * I(During) + Controls_{it} + \varepsilon_{it}. \quad (1)$$

In this specification, *Tone* is either the average *overall* RavenPack media sentiment score, media-initiated coverage sentiment (*Financial Media Tone*), or firm-initiated press release sentiment (*Press Release Tone*). *I(During)* is an indicator variable set equal to one for observations occurring during the period May 2005 to end of July 2007, and zero otherwise. *I(Pilot)* is an indicator variable set equal to one for observations related to pilot firms in any period, and zero otherwise. Our main variable of interest in (1) is the interaction term *I(Pilot)*I(During)*, which equals 1 for pilot firms' observations during the SHO experiment period, and zero otherwise. We predict that the coefficient α_1 on the interaction term *I(Pilot)*I(During)* will be negative, reflecting a significant decrease in media sentiment for pilot firms during the experiment relative to control firms. We also run a Probit version of specification (1) where *Tone* is replaced by *I(Negative)*, an indicator variable set equal to one if news sentiment is negative (i.e., CSS < 50), and zero otherwise. In this specification, we predict that the probability of negative news sentiment will be higher for pilot firms during the experiment relative to control firms (i.e., $\alpha_1 > 0$).

We include a wide range of variables to control for firm characteristics that are known to be related to a firm's information environment. Specifically, we control for firm size (*Size*) since larger firms are likely to attract relatively higher media coverage. Similarly, the media may choose which firms to cover based on profitability (*ROA*), growth opportunities (*MTB*) or asset growth (*Asset growth*). We include leverage (*Leverage*) to control for firms' capital structure and financial distress likelihood, which may influence the sentiment of media coverage. We also include firm fixed or industry fixed effects. Standard-errors are clustered by firm.

In some analyses, we additionally control for properties of firms' publicly traded equity as past equity performance may impact investors' attention and thus influence coverage decisions of the financial press. These additional controls include lagged stock returns (*Ret*); stock returns

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volatility (*StdRet*); bid-ask spread (*BidAsk*); trading volume (*Vol*); and illiquidity (*Illiquidity*). All variables are defined in Appendix A.

In table 2 we provide descriptive statistics on these control variables. In panel A, we formally examine differences between control and pilot firms for the year of 2003, the year before the selection of firms to the pilot group. Similar to Fang et al. (2016), we observe that the pilot group and the control group are statistically similar in size, return on assets, leverage, market-to-book, asset growth and tone. Further, untabulated estimations from Probit models show that firm characteristics do not predict the likelihood of the firm being selected in the pilot program from Reg SHO (p-value = .31 for the model). This evidence is consistent with the unpredictability of the experiment and alleviates concerns of endogeneity.

4.2 Short Selling Constraints and Negative Media Coverage: Empirical Results

Table 3 reports results from estimating the specification described by equation (1). In columns (1) and (2) the dependent variable is *Tone*, which is the quarterly average of the overall RavenPack media sentiment score inclusive of both media-initiated articles and firm-initiated press releases. In column (1) we control for firm fixed effects, while column (2) controls for industry fixed effects. In both columns (1) and (2) the coefficient on the interaction term *I(Pilot)*I(During)*, α_1, is negative and significantly different from zero. This shows that following reduction in short selling constraints, media coverage sentiment for pilot firms decreased significantly relative to that of control firms. In column (3) of table 3 we report results from a Probit version of equation (1) where *Tone* is replaced by *I(Negative)*, an indicator variable set equal to one if news sentiment is negative, and zero otherwise. In column (3) the coefficient on the interaction term *I(Pilot)*I(During)* is positive and significantly different from zero, showing that the probability of negative news coverage for pilot firms increased significantly relative to that of control firms. The

results in table 3 are consistent with our hypothesis that a relaxation of short selling constraints amplifies short selling activity and increases the extent to which negative news about firms is reported by the business press.

In table 3 we see that the coefficient on *I(Pilot)* is not significantly different from zero in any of the three specifications, suggesting that there was no difference between pilot and control firms prior to implementation of SHO. The positive and significant coefficient on *I(During)* in columns (1) and (2) indicates that media sentiment of non-pilot firms is higher during the SHO experiment relative to the pre-pilot period., while the negative and significant coefficient on *I(During)* in column (3) indicates that the probability of negative news sentiment for non-pilot firms is lower in the pilot period than in the preceding period. Table 3 also shows that media sentiment is higher for more profitable firms, high-growth firms and firms with higher asset growth. On the other hand, media sentiment is lower for firms with higher leverage. These results suggest that media content is significantly related to firms' fundamentals.

To rule out the possibility that the change in media coverage for pilot firms during the SHO experiment was somehow unrelated to the change in short selling costs, we expand the analysis from table 3 to include the post-experiment period from August 2007 to October 2009. After July 2007 all firms faced the same short selling constraints as the SEC also exempted the control stocks from short sale price tests. If the decrease in media sentiment for pilot firms relative to control firms documented in table 3 is a consequence reduced short selling constraints, then we would expect these differences to disappear once short selling costs are equalized in the period following the SHO experiment. To examine this, we define the indicator variable *I(Post)* as equal to one during the time period August 2007 to October 2009, and zero otherwise. We see in table 4 that the coefficient on the indicator variable *I(Pilot)* I(Post)* is not significantly different from zero in

any of the specifications, implying that, relative to the time period prior to the implementation of SHO, there was no change in media sentiment for pilot firms as compared to control firms following the end of the SHO experiment.

In table 5 we report cross-sectional analysis examining the proposition that the incentives of short sellers to disseminate negative news are greater in settings that provide short sellers with greater opportunity for profitable information advantage. We posit that short sellers have greater scope for advantage when firms have lower levels of publicly available information and when investors face more information asymmetry. We predict that the decrease in media sentiment for pilot firms during the treatment period documented earlier will be more pronounced for firms with weaker information environments in which short sellers have greater incentives to collect information, take short positions and disseminate news to the media.

Specifically, we partition our sample into high and low groups based on three characteristics of information environment, all measured in 2003, the year prior to the start of the experiment: the intensity of media coverage measured by number of news articles published about over the quarter, institutional ownership level and bid-ask spread (all variables are defined in appendix A). We designate firms above the 75th percentile on a given characteristics as High group firms and those below the 75th percentile as Low group firms. We run the difference-in-difference design described in equation (1) separately for the high and low partitions of each information variable. Table 5 reports that the drop in overall sentiment of media coverage for pilot firms post SHO-implementation is significantly greater for firms with low media coverage intensity, low institutional ownership levels and high bid-ask spreads. This result is consistent with short sellers adopting more aggressive media dissemination strategies for firms whose information environments provide more scope for profitable short selling.

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4.3 Distinguishing media-initiated coverage and firm-initiated press releases

Up to this point, we have not distinguished articles initiated by the media from firm-initiated press releases. This distinction is potentially important as changes in disclosure strategy for firms facing increased short selling pressure following relation of short selling constraints may differ substantially from changes in the information dissemination strategy of short sellers and news coverage decisions of the financial press. Firms' managers' may adopt press release strategies to counteract any increased flow of negative news by imbuing their press releases with a more positive spin, by releasing negative news earlier given that short sellers are likely to drive it into prices anyway, or by reducing the precision of bad news to minimize its impact on stock prices,. There is mixed evidence to date on how short selling constraints influence management forecasts, where Cheng et al. (2014) finds that managers react to increase in short selling pressure by releasing more good news, Clinch et al. (2016) finds that firms significantly increase bad news disclosure with no effect on good news, and Li and Zhang (2015) find that managers do not change the likelihood of issuing a good or a bad news forecasts but do reduce the precision of bad news forecasts. In a related study, Fang et al. (2016) find that firms decrease earnings management behavior following a reduction short selling costs.

We extend the literature by examining how firms' press release strategies respond to changes in short selling costs. We disaggregate media sentiment into press releases that are initiated by the firm (*PR Tone*) and news that is initiated by outsiders (*FM Tone*). We then run the difference in differences specification separately for each sentiment variable. Table 6 reports the results of this analysis. Panel A reports that the average treatment effect is negative and significant only for *FM Tone*, where we find no effect on *PR Tome*. To address the possibility that there is a

fundamental relationship between the sentiment of press releases and media-initiated, in Table 6, panel B we rerun the analysis separately for *FM Tone* and *PR Tone* while also including the other tone measure. Results show that while there is a strong positive association between *FM Tone* and *PR Tone*, it remains the case that the average treatment effect is negative and significant only for financial press-initiated coverage.[12]

Finally, Niessner and So (2018) show that the financial press is more likely to cover firms with deteriorating performance, documenting that a greater *number* of pre-announcement articles foreshadows negative earnings announcement news. This raises the interesting issue of whether a reduction in short selling costs increases the intensity of news coverage as measured by the number of articles published. In table 7, column (3) we document that indeed the number of media-initiated articles increased significantly for pilot firms relative to control firms during the treatment period. We also explore how the intensity of press release activity was impacted by Regulation SHO. In table 8, column (2), we find that the intensity of media-initiated articles increased significantly for pilot firms relative to the intensity of press releases, and in column (4) we document that intensity of press release activity actually decreased for pilot firms relative to control firms during the treatment period. Thus, while the sentiment of press releases was not impacted by the reduction in short selling costs, press release activity decreased significantly after controlling for the number of media-initiated articles.

5. Short Selling Constraints, Negative News, Arbitrage Capital and Price Discovery

While our earlier analyses considered the impact of short selling constraints on negative media coverage, we now take media coverage as given and study how short selling constraints impact the flow of arbitrage capital and price discovery surrounding negative news coverage. We

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[12] These results are robust to including controls for a firm's litigation risk and level of short interest.

hypothesize that lower short selling costs will bring more arbitrage capital and informed trading pressure to bear on negative news, and thereby increase the speed and intensity with which negative news reports are impounded into stock price. In section 5.1 we examine how short selling constraints impact the association between stock returns and negative news. In section 5.2 we examine how short selling constraints influence the flow of arbitrage capital to news sentiment-based trading strategies.

5.1 Short Selling Costs and Associations between Negative News and Stock Returns

To the extent that a relaxation of short selling constraints increases short selling activity, it is plausible that more informed trading pressure will be brought to bear on negative media news coverage. The idea here is that by easing limits to arbitrage short sellers will be incentivized to more aggressively seek out and trade on negative news, and thereby heighten the relation between stock returns and negative news. We predict that relative to control firms, the stock returns of pilot firms will decrease significantly more in response to negative media during the treatment period.

To investigate this claim, we run an OLS regression of daily stock returns on contemporaneous news sentiment for that day. We limit the analysis to firm days for which there is at least one news article reported in RavenPack. For ease of exposition, we run the analysis separately for the pre-period and the treatment period. *I(Negative)* is an indicator variable set equal to one if average news sentiment on a given day is negative, and zero otherwise. Results of this analysis are reported in table 8. We see that the coefficient on the interaction term *I(Negative)*I(Pilot)* is negative and statistically significant only during the pilot period, where the difference in coefficients across the two sub-periods are significantly different from each other. This result shows that when short selling constraints are relaxed, short sellers more aggressively impound the information contained in negative news into contemporaneous stock returns.

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5.2 Short selling costs and flows of arbitrage capital to news sentiment-based strategies

In this section we extend the previous analysis by more directly investigating changes in arbitrage activities driven by reductions in short selling costs. If lower short selling costs reduce limits to arbitrage, we expect changes in short selling behavior to result in an increased flow of arbitrage capital to news sentiment-based trading strategies, and to increase the speed and intensity with which negative news is impounded into prices. We examine this claim using two different analyses.

Our first analysis uses the methodology developed by Hanson and Sunderam (2014). The Hanson and Sunderam (2014) methodology exploits time-variation in the cross-section of short interest to infer the amount of capital allocated to specific, quantitative equity arbitrage strategies (see also Guest et al., 2018). Applying this methodology to our setting, we exploit variation in monthly short-interest levels to estimate the responsiveness of short interest levels to negative news sentiment. We obtain short interest data from February 2003 through July 2007. For NYSE and AMEX stocks we use short-interest data from Compustat, and for NASDAQ stocks we obtain data directly from the exchange. Our empirical specification adapts the regression model in Hanson and Sunderam (2014) to incorporate short selling strategies that utilize the sentiment of media news coverage.

To make the structure of our difference in differences design clear, we first specify the basic formulation used in Hanson and Sunderam (2014) and Guest et al. (2017), and then expand it to incorporate the Regulation SHO experiment. The basic formulation is:

$$SIR_{im} = \alpha_m + \kappa^{News} * I(Decile_{News})_{im} + Controls + \varepsilon_{im}. \tag{2}$$

In equation (2), SIR_{im} is the short interest ratio (in percentage terms) for firm i in month m, defined as the total number of shares sold short on or before the 15th of the month divided by shares

outstanding. Equation (2) is implemented by regressing firms' monthly short interest ratio on news sentiment signals measured over the 15 days ending on the 15th of month m. We only include observations in each month for firms with at least one news article reported by RavenPack during the 15 day window. The news sentiment signal is expressed as a set of decile dummy variables (omitting the fifth decile). That is, for each month in the sample we rank news sentiment across firms and sort firms into deciles. We then create an indicator variable $I(Decile_{News})$, one for each decile of news sentiment (excluding decile 5), where this indicator takes on a value of one if a firm's news sentiment for that month falls in the given decile, and zero otherwise.

The parameter κ_{news} in equation (2) denotes a vector of estimated coefficients, with one coefficient for each decile-signal pairing. Hanson and Sunderam (2014) make the case that the flow of arbitrage capital to a strategy is captured by the coefficient on the lowest decile, $\kappa^{News,lowest}$. In our setting, this coefficient reflects the sensitivity of short interest to the lowest decile of news sentiment relative to the fifth decile.

To implement our difference in differences design we adapt equation (2) as follows:

$$
\begin{aligned}
SIR_{im} = \alpha_m &+ \kappa_1^{News} I(Decile_{News}) \cdot I(During) \cdot I(Pilot) + \kappa_2^{News} * I(During) \cdot I(Pilot) \\
&+ \kappa_3^{News} \cdot I(Decile_{News}) + Other\ Main\ Effects + Lower\ Order\ Interactions \\
&+ Other\ Aribtrage\ Strategies + Controls + \varepsilon_{im}.
\end{aligned}
\tag{3}
$$

Our main interest is in the coefficient $\kappa_1^{News,lowest}$ on the lowest decile of news sentiment. This coefficient captures the differential intensity of the response of short interest to extreme negative news for pilot firms relative to control firms during the treatment period. We predict that the short interest of pilot firms will be more sensitive to negative news relative to control firms in the treatment period as indicated by $\kappa_1^{News,lowest} > 0$ for the lowest decile of news sentiment.

Following Hanson and Sunderam (2014) and Guest et al. (2018), our controls include stock exchange dummies, institutional ownership, daily turnover averaged over the prior three months, size, trailing twelve-month return volatility, a convertible securities outstanding dummy and year-month fixed effects. We further control for three additional quantitative trading strategies: size, book to market and momentum, where the signals for these strategies are measured in the prior month (i.e., *m-1*). Again, each signal is expressed as a set of decile dummy variables (omitting the fifth decile). We have no predictions on how these strategies will respond to a reduction in short selling constraints. For example, Geczy, et al. (2002) provides evidence that short-selling constraints have a limited impact on well-accepted arbitrage portfolios such as size, book-to-market, and momentum portfolios.

The results of this analysis are reported in table 9. In column (1) we run a baseline regression where we only examine *I(Pilot)*I(During)* without including any news sentiment variables. Consistent with prior research (e.g., Diether et al., 2009; Grullon et al., 2015), the coefficient on *I(Pilot)*I(During)* is positive and significant, indicating that short interest increased on average for pilot firms relative to control firms during the pilot period. In columns (2)-(5) we implement the full difference in differences design while also controlling for other arbitrage strategies (Hanson and Sunderam, 2014; Guest et al., 2018). Table 9 shows that short interest for pilot firms becomes more sensitive to negative news, where the coefficient on *I(Decile1_{News})*I(Pilot)*I(During)* for the lowest decile, $\kappa_1^{News,lowest}$, is positive and significantly different from zero in all specifications. Following the interpretation from Hanson and Sunderam (2014), the fact that short interest is significantly more sensitive to the lowest news sentiment decile for pilot firms in the treatment period implies that more arbitrage capital was directed to news sentiment-based trading strategies.

Given our finding of more arbitrage capital being directed to news sentiment-based trading strategies, our final analysis examines whether this increased arbitrage intensity results in an increase in the speed with which excess returns due to overpricing are eliminated. Hanson and Sunderam (2014) provide evidence that increasing level of arbitrage capital is associated with a reduction in the returns that anomaly trading strategies deliver, suggesting higher shorting demand is associated with declining profitability of anomaly strategies. Further, Chu et al. (2019) find that after short selling constraints were relaxed, 11 well-known asset pricing anomalies became significantly weaker on portfolios constructed with pilot stocks during the pilot period. We examine this in the context of a news sentiment-based trading strategy and a reduction in short selling costs driven by Regulation SHO. We predict that excess returns from a news sentiment-based trading strategy will decrease for pilot firms relative to control firms following a reduction in short selling costs.

Specifically, we study the ability of an investor to earn abnormal returns by trading on past news' sentiment. Tetlock et al. (2008) document the existence of abnormal returns to a news sentiment-based trading strategy. Following Tetlock et al. (2008), we construct long-short portfolios based on news sentiment at the close of each trading day. Specifically, we form two equal-weighted portfolios based on the sign of a firm's news sentiment during the prior trading day. Negative news is indicated by a RavenPack CSS< 50. We include all firms with positive news stories in the long portfolio and those with negative news stories in the short portfolio.[13] As in Tetlock et al. (2008), we hold both the long and short portfolios for one full trading day and rebalance at the end of the next trading day. To control for systematic risk, we use either the Fama-French 3 factors or the Carhart 4 factor model. The results of this analysis are reported in table 10.

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[13] To perform the returns analysis, we remove the Regulation SHO announcement period.

The results show a modest decrease in abnormal returns (i.e., alpha) for the treatment group relative to the control during the experiment.

The results in this section provide evidence consistent with a relaxation in short selling constraints decreasing limits and increasing sensitivity of stock returns to negative media coverage, and with a greater flow of arbitrage capital and lower abnormal returns to news sentiment-based trading strategies. This evidence combined with our earlier analyses show that a relaxation of short selling constraints impact leads to a more negative tilt in firms' media coverage and fundamental change in the relation between negative news and stock price formation.

6. Robustness Analysis

We examine a number of alternative explanations for our results. One potential explanation is that media content is explained by past (and current) equity performance. Previous studies suggest that returns and news are related (Tetlock et al. (2008). Additionally, it is possible that news sentiment is explained by price disagreement reflected in return volatility, or that news sentiment is explained by trading volume or stock illiquidity. To explore these alternatives, we add additional controls (all variables are described in appendix A). These include lagged and contemporaneous stock returns (*Ret*), return volatility (*StdRet*) and Amihud's measure of stock illiquidity (*Illiquidity*). In untabulated results we find that all of our inferences continue to hold, and that more negative media news flows to the market following reduction in short selling costs.

Another alternative is that media sentiment mirrors information supplied by other information intermediaries, such as financial analysts. To explore this alternative, we include measures of average forecast error (*AFE*) and analyst coverage (*Coverage*) as independent variables and find that our inferences remain the same.

Finally, media reporting could simply be a consequence of observed increases in short selling pressure. To evaluate this hypothesis we further control for the amount of short interest and find similar results. Specifically, we include a percentile variable measuring the amount of stocks shorted, ranging from 1 to 10. Again all inferences remain unchanged. Finally, our results are also robust to eliminating Regulation SHO's announcement period (June 2004 to April 2005), or including the earnings announcement date when constructing our on our sentiment measure.

7. Summary

The central importance of information to the vibrancy of public capital markets and capital market outcomes has spawned a vast literature examining the forces that shape the information environments of publicly traded firms. Much of this literature examines the information disclosure and dissemination decisions of firm managers (e.g., Miller and Skinner, 2015; Beyer et al., 2010) and the role of sell-side analysts as key information intermediaries (e.g., Bradshaw, et al., 2017).

In addition, an evolving literature documents the importance of the business press as an important information intermediary in financial markets (e.g., Miller and Skinner, 2015; Tetlock, 2014; Bushee, 2010). Much of the research to date takes the media's coverage decisions as given and investigates market consequences of observed coverage. We extend the literature by allowing for media coverage to be endogenously determined. Specifically, we investigate how shifts in securities regulation that reduces constraints on short selling can induce changes in media coverage by changing the incentives of short sellers to disseminate negative news through the media. Building on extensive evidence that short selling constraints represent an important limit to arbitrage that inhibits informed investors from profitably short selling stocks they believe are overpriced, we hypothesize that a relaxation of short selling constraints will (1) increase the extent to which negative news about firms is reported by the business press; and (2) increase the flow of

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arbitrage capital to news sentiment-based trading strategies, and increases the speed and intensity with which negative news reports are impounded into stock price.

Exploiting the randomized Regulation SHO experiment to identify effects of short-sale constraints, we find that following reduction in short selling costs the sentiment of pilot firms' press coverage tilts significantly more negative and the probability of their receiving negative news coverage increases. This result holds for media-initiated articles, but not for firm-initiated press releases, and is more pronounced for more opaque firms where short sellers are likely to have greater scope for relative information advantage. Consistent with short-sale constraints limiting arbitrage activities, we find that following relaxation of short selling constraints stock returns become more sensitive to negative news reports, more arbitrage capital is allocated to news sentiment-based trading strategies and such trading strategies earn lower abnormal returns.

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Appendix A

Variable name	Variable Definition
CSS	Composite Sentiment Score from 0 to 100. Extract from RavenPack. It represents the news sentiment of a given story by combining various sentiment analysis techniques. The direction of the score is determined by looking at emotionally charged words and phrases and by matching stories typically rated by experts as having short-term positive or negative share price impact. The strength of the score is determined from intraday stock price reactions modeled empirically using tick data form approximately 100 large cap stocks. Typically, CSS scores between 40-60 so higher(lower) values are assigned only in cases where confidence is high on short term signals.
Tone	Average Composite Sentiment Score. Estimation period spans from 90 days before Earnings Announcement Day until one day before the announcement day.
Financial Media Tone	Average Composite Sentiment Score from media-initiated news. Estimation period spans from 90 days before Earnings Announcement Day until one day before the announcement day.
Press Release Tone	Average Composite Sentiment Score from news initiated by the firm. Estimation period spans from 90 days before Earnings Announcement Day until one day before the announcement day.
I(Pilot)*I(During)	Indicator function equals one if firm is in the Pilot Program during the experiment period, zero otherwise.
I(Pilot)	Dummy equals one if firm is in the Pilot Program, zero otherwise.
I(Dur)	Dummy equals one between May 2005 to July 2007, zero otherwise.
I(Post)	Dummy equals one between August 2007 to October 2009, zero otherwise
Leverage	Current liabilities plus long term debt over total assets: i.e., (DLT T Q + DLC Q)/(DLT T Q + DLC Q + SEQQ) from Compustat.
Size	Natural log of Total Assets from Compustat estimated the quarter prior to the earnings announcement.
Asset Growth	Total Asset Growth. Computed as log(atq/lag(atq)). From Compustat. Estimated the year prior to SHO becoming active.
ROA	Return on Assets. Computed as Owe BDP Q/atq. From Compustat Quarterly..
MTB	Market to book. Computed as csho $*$ prccq/ceq.
Ret	Yearly cumulative daily return ending 3 months before EAD. Extract from CRSP.

StdRet	Yearly moving standard deviation of daily returns. Calculated using 360 days ending 3 months before the EAD. Used as control variable.
I(High Media)	Indicator function equals one if firm is in the top quartile of media coverage distribution before the experiment, zero otherwise. Media coverage is measured as the average number of articles of a given firm in before the experiment
I(High InstOwn)	Indicator function equals one if firm is in the top quartile of institutional ownership holdings before the experiment, zero otherwise.
I(High Spread)	Indicator function equals one if firm is in the top quartile of bid-ask spread before the experiment, zero otherwise.
Illiquidity	Yearly moving average of daily illiquidity. Amihud's Illiquidity is calculated using 360 days ending 3 months before the EAD.
Short Interest	Percentile amount of short interest extracted from Compustat Supplemental Short Interest File. Short Interest range from 1 to 10 in which higher percentile means higher amount of short selling.
AFE	Average Analyst Forecast Error in which Forecast error is measured as ACTUAL Estimated
Coverage	Number of analysts following the firm on I/B/E/S.

Table 1: Sample Selection

Filters Number of observations	Observations	Unique firms	Treated Firms
Compustat, CRSP and IBES data from 2000 to 2010 for Russell 3000 index firms	62,868	2734	889 (32,9%)
After elimination of the observation of firms not covered by RavenPack	45,487	2587	845 (32,7%)
After elimination of the observations not included in study period	43,513	2585	844 (32,6%)
After elimation of financial and utilities firms (SIC 6000-6999) and (SIC 4900 - 4949)	38,677	2376	768 (32,3%)
Analysis including periods before and during Regulation SHO	25,743	2306	749 (32,8%)

Table 2: Panel A: Descriptive statistics by group for the year of 2003, the year before the selection of firms to the pilot group

Variable	Mean Control	Mean Treated	Diff.	T-stat	P-value
Media Sentiment					
Tone	50.49	50.47	-0.02	0.36	0.72
Financial Media Tone	49.44	49.49	0.05	0.75	0.46
Press Release Tone	51.51	51.56	0.05	1.17	0.24
Firms Characteristics					
MTB	7.04	7.08	0.04	0.49	0.62
Size	0.03	0.04	0.01	1.63	0.10
ROA	0.03	0.03	0.00	1.17	0.24
Lev	3.13	3.42	0.29	1.27	0.21
Asset Growth	0.35	0.35	0.01	0.28	0.78
Additional Controls					
StdRet	0.04	0.03	0.00	2.51	0.01**
Ret	0.00	0.00	0.00	0.51	0.61
Coverage	6.25	6.49	0.23	0.86	0.39
Average Forecast Error	0.02	0.03	0.01	0.84	0.40
Forecast Dispersion	0.03	0.03	0.00	0.94	0.35
Illiquidity	0.63	0.55	-0.08	0.78	0.44
Short Interest	5.50	5.48	-0.01	0.10	0.92

Panel B: Descriptive statistics for all the sample (including the post period).

	Mean	Std	Min	Q1	Q2	Q3	Max
Control							
Tone	51.00	1.59	28.67	50.13	51.19	52.03	75.00
FM Tone	49.79	3.06	4.00	48.58	50.33	51.61	75.00
PR Tone	52.03	1.30	24.50	51.23	52.00	52.87	65.57
MTB	3.06	3.38	-6.97	1.54	2.33	3.66	20.60
Size	7.24	1.67	3.37	6.02	7.17	8.27	12.32
ROA	0.03	0.04	-0.18	0.01	0.03	0.05	0.26
Leverage	0.34	0.29	0.00	0.05	0.31	0.53	2.73
AssetGrowth	0.02	0.09	-0.60	-0.01	0.01	0.04	0.67
Coverage	6.57	5.29	1.00	3.00	5.00	9.00	29.00
Pilot							
Tone	51.01	1.53	32.00	50.17	51.16	52.00	57.50
FM Tone	49.88	2.82	11.00	48.62	50.33	51.67	67.50
PR Tone	52.02	1.28	39.00	51.21	52.00	52.85	65.00
MTB	3.09	3.10	-6.97	1.57	2.27	3.62	20.60
Size	7.27	1.64	3.37	6.14	7.12	8.32	12.12
ROA	0.03	0.04	-0.18	0.01	0.03	0.05	0.15
Leverage	0.31	0.27	0.00	0.05	0.29	0.49	1.95
AssetGrowth	0.02	0.09	-0.59	-0.01	0.01	0.04	0.67
Coverage	6.70	5.40	1.00	3.00	5.00	9.00	29.00
All							
Tone	51.01	1.57	28.67	50.14	51.18	52.02	75.00
FM Tone	49.82	2.98	4.00	48.60	50.33	51.63	75.00
PR Tone	52.03	1.29	24.50	51.22	52.00	52.86	65.57
MTB	3.07	3.29	-6.97	1.55	2.31	3.65	20.60
Size	7.25	1.66	3.37	6.06	7.15	8.29	12.32
ROA	0.03	0.04	-0.18	0.01	0.03	0.05	0.26
Leverage	0.33	0.29	0.00	0.05	0.30	0.51	2.73
AssetGrowth	0.02	0.09	-0.60	-0.01	0.01	0.04	0.67
Coverage	6.61	5.33	1.00	3.00	5.00	9.00	29.00

Table 3: **Effect of Short Selling Constraints on Negative Media Tilt**
This table examines the effect of short selling constraints on news sentiment. Specifically, we estimate the equation $Tone_{it} = \beta_0 + \beta_1 I(Pilot) * I(Dur) + X\Gamma + \epsilon_{it}$. Tone is the quarterly average Composite Sentiment Score from RavenPack. Our main variable of interest is I(Pilot)*I(Dur). I(Pilot) equals one if the firm is in the pilot program, zero otherwise. I(Dur) is set equal to one between May 2005 and July 2007, and zero otherwise. Columns 1-2 report results from OLS regressions. Column 3 reports the marginal effects from a logit regression where the dependent variable is I(negative), which is set equal to one if average news sentiment is negative ($CSS < 50$), and zero otherwise. X is a vector of controls that include ROA, Book-to-Market, Size, Leverage and Asset Growth. All variables are defined in the appendix A. ***, **, * indicates significance at the 0.01, 0.05, 0.10 level, respectively. Standard errors are clustered by firm.

	(1)	(2)	(3)
	Tone	Tone	I(Negative)
I(Pilot)*I(Dur)	−0.09***	−0.08***	0.02**
	(−2.92)	(−2.78)	(2.18)
I(Pilot)	0.00	0.07	−0.02
	(.)	(1.11)	(−1.60)
I(Dur)	0.06***	0.06**	−0.03***
	(2.61)	(2.53)	(−5.76)
MTB	0.00	0.00*	
	(1.42)	(1.76)	
Size	0.08**	−0.00	
	(2.03)	(−0.14)	
ROA	0.58	1.81***	
	(1.63)	(5.24)	
Leverage	−0.14**	−0.27***	
	(−2.07)	(−4.48)	
AssetGrowth	0.18***	0.13**	
	(2.60)	(2.00)	
Constant	50.56***	51.10***	
	(189.27)	(358.58)	
N	22482	22482	22482
Firm FE	Y	N	N
Year FE	Y	Y	N
Industry FE	N	Y	N
Controls	Y	Y	Y

Table 4: **Effect of Short Selling Constraints on Negative Media Tilt: Post-Regulation SHO**

We estimate $Tone_{it} = \beta_0 + \beta_1 I(Pilot) * I(Dur) + X\Gamma + \epsilon_{it}$. Tone is the quarterly average Composite Sentiment Score from RavenPack. Our main variables of interest I(Pilot)*I(Dur) and I(Pilot)* I(Post). I(Pilot) equals one if the firm is in the pilot program, zero otherwise. I(Dur) is set equal to one between May 2005 and July 2007, and zero otherwise. I(Post) is set equal to one between August 2007 to October 2009, and zero otherwise. X is a vector of controls that include ROA, Book-to-Market, Size, Leverage and Asset Growth. All variables are defined in the appendix A. ***, **, * indicates significance at the 0.01, 0.05, 0.10 level, respectively. Standard errors are clustered by firm.

	(1)	(2)
	Tone	Tone
I(Pilot)*I(Post)	−0.03	−0.03
	(−1.14)	(−1.08)
I(Pilot)*I(Dur)	−0.05**	−0.05**
	(−2.23)	(−2.17)
I(Dur)	0.01	0.07***
	(0.79)	(5.11)
I(Pilot)	0.00	0.00
	(.)	(.)
I(Post)	−0.01	0.05***
	(−0.42)	(2.93)
MTB	0.00	0.00
	(1.44)	(1.62)
Size	0.06***	0.07***
	(3.07)	(3.81)
ROA	0.37	0.38
	(1.53)	(1.58)
Leverage	−0.07*	−0.07**
	(−1.84)	(−1.96)
AssetGrowth	0.08	0.09*
	(1.64)	(1.86)
Constant	50.61***	50.46***
	(347.41)	(358.54)
N	33648	33648
Firm FE	Y	N
Year FE	Y	Y
Industry FE	N	Y

Table 5: **Effect of Short Selling Constraints on Negative Media Tilt: Cross-sectional Analysis**
We split our sample based on firms characteristics measured in 2003, the year before the experiment. The characteristics we examine are the number of articles, institutional ownership level, and bid-ask spread. We designate firms above the 75th percentile as High and those below the 75th percentile as Low. We estimate $Tone_{it} = \beta_0 + \beta_1 I(Pilot) * I(Dur) + X\Gamma + \epsilon_{it}$. *Tone* is the quarterly average Composite Sentiment Score extracted from RavenPack. Our main variable of interest is *I(Pilot)*I(Dur)*. *I(Pilot)* equals one if the firm is in the pilot program, zero otherwise. I(Dur) is set equal to one between May 2005 and July 2007, and zero otherwise. X is a vector of controls that include ROA, Book-to-Market, Size, Leverage and Asset Growth. All variables are defined in the appendix A. Standard errors are clustered by firm. ***, **, * indicates significance at the 0.01, 0.05, 0.10 level, respectively. †††, ††, † represent the significance of the difference in coefficients across columns at the 0.01, 0.05, and 0.10 level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	High Media	Low Media	High InstOwn	Low InstOwn	Low Spread	High Spread
I(Pilot)*I(Dur)	−0.03	−0.11***	−0.06*	−0.20***	0.05	−0.13***
	(−1.50)	(−2.67)†	(−1.91)	(−2.66)†	(0.71)	(−3.80)††
I(Dur)	0.00	0.08**	0.06**	0.03	−0.02	0.08***
	(0.08)	(2.23)	(2.36)	(0.44)	(−0.42)	(2.65)
MTB	0.00	0.01*	0.00**	0.00	0.01	0.00
	(0.40)	(1.91)	(2.06)	(0.10)	(1.59)	(0.94)
Size	−0.02	0.12**	0.11***	0.03	0.16**	0.06
	(−0.99)	(2.37)	(2.64)	(0.24)	(2.41)	(1.29)
ROA	0.34*	0.70	1.21***	−0.98	1.30*	0.36
	(1.90)	(1.57)	(2.89)	(−1.32)	(1.81)	(0.86)
Leverage	0.08	−0.10	−0.05	−0.33**	−0.02	−0.18**
	(1.12)	(−1.56)	(−1.18)	(−2.27)	(−0.71)	(−1.98)
AssetGrowth	−0.05	0.26***	0.12	0.45***	0.42***	0.13
	(−0.92)	(3.00)	(1.55)	(2.67)	(3.03)	(1.53)
Constant	51.15***	50.47***	50.43***	50.86***	49.66***	50.87***
	(238.77)	(156.28)	(171.65)	(61.61)	(106.99)	(148.67)
N	5330	17080	17932	4478	4605	17805
R^2	0.00	0.01	0.01	0.01	0.01	0.01
Year FE	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y

Table 6: **Distinguishing Firm-initiated Press Releases and Media-initiated Articles**
This table disaggregates media sentiment into press releases that are initiated by the firm (PR Tone) and news that is initiated by outsiders (FM Tone). We estimate the following linear model $Y_{it} = \beta_0 + \beta_1 I(Pilot) * I(Dur) + X\Gamma + \epsilon_{it}$. $Y_i t$ is one of two measures of news sentiment: FM tone or PR Tone. FM Tone is the quarterly average tone articles not initiated by the firm. PR Tone is the quarterly average tone for firm-initiated press releases. Our main variable of interest is I(Pilot)*I(Dur). I(Pilot) equals one if the firm is in the pilot program, zero otherwise. I(Dur) is set equal to one between May 2005 and July 2007, and zero otherwise. X is a vector of controls that include ROA, Market-to-book, Size, Leverage and Asset Growth. All variables are described in the Appendix A. Panel A presents the results from estimating equations isolated. Panel B repeat the analyses by controlling for the sentiment of the alternative source. ***, **, * indicates significance at the 0.01, 0.05, 0.10 level, respectively. Standard errors are clustered by firm.

| | Panel A:Sentiment by source | | | |
	FM Tone	PR Tone	FM Tone	PR Tone
I(Pilot)*I(Dur)	−0.12**	−0.04	−0.12**	−0.03
	(−2.54)	(−1.54)	(−2.53)	(−1.44)
I(Pilot)	0.00	0.00	0.22	−0.01
	(.)	(.)	(1.60)	(−0.23)
I(Dur)	0.05	0.04*	0.04	0.04**
	(1.23)	(1.89)	(0.93)	(2.03)
N	21701	22185	21701	22185
Year FE	Y	Y	Y	Y
Industry FE	N	N	Y	Y
Firm FE	Y	Y	N	N
Controls	Y	Y	Y	Y

| | Panel B: Controlling for other source sentiment | | | |
	FM Tone	PR Tone	FM Tone	PR Tone
I(Pilot)*I(Dur)	−0.11***	−0.02	−0.11***	−0.02
	(−2.61)	(−1.04)	(−2.58)	(−0.88)
PR_Tone	0.17***		0.20***	
	(3.70)		(4.58)	
FM_Tone		0.03***		0.04***
		(3.53)		(4.71)
N	21404	21404	21404	21404
Year FE	Y	Y	Y	Y
Industry FE	N	N	Y	Y
Firm FE	Y	Y	N	N
Controls	Y	Y	Y	Y

Table 7: **Short Selling Constraints and Number of Articles Published**
We estimate $\#Articles_{it} = \beta_0 + \beta_1 I(Pilot) * I(Dur) + X\Gamma + \epsilon_{it}$. $\#Articles$ refers to the number of articles in the quarter in which we have a sentiment (CSS) score. Our main variable of interest is I(Pilot)*I(Dur). I(Pilot) equals one if the firm is in the pilot program, zero otherwise. I(Dur) is set equal to one between May 2005 and July 2007, and zero otherwise. X is a vector of controls that include ROA, Book-to-Market, Size, Leverage and Asset Growth. All variables are defined in the appendix A. ***, **, * indicates significance at the 0.01, 0.05, 0.10 level, respectively. Standard errors are clustered by firm.

| | (1) | (2) | (3) | (4) |
	All	$\#FM - \#PR$	# Full Articles	# Press-Releases
I(Pilot)*I(Dur)	0.12	0.31**	0.27**	−0.24*
	(0.36)	(2.15)	(2.15)	(−1.77)
I(Dur)	−0.12	−0.39***	−0.34***	0.31**
	(−0.47)	(−2.87)	(−3.09)	(2.37)
Press-Releases			0.65***	
			(34.07)	
Full-Articles				0.68***
				(34.55)
N	22388	22388	22388	22388
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y

Table 8: **Short Selling Costs and the Association between Stock Returns and Negative News**
This table presents the results of estimating. $R_{it} = \beta_0 + \beta_1 I(Negative) * I(Pilot) + X\Gamma + \eta_{it}$ for each of the two different sample periods (Pre and During Regulation SHO). R_{it} is firm is market-adjusted daily return at time t. Our main variable of interest is the information content of negative news for the treatment group, which is captured by the interaction I(Negative)*I(Pilot). I(Pilot) and I(Dur) are defined as before. I(Negative) equals one if $CSS < 50$, and zero otherwise. X is a vector of controls that include all the indicator variables (main effects) and its interactions, lagged daily market-adjusted return (return it-1), analyst following, dispersion in the most recent analyst forecasts and the number of articles about the firm on day t. Standard errors are clustered by date. Standard errors are clustered by firm. ***, **, * indicates significance at the 0.01, 0.05, 0.10 level, respectively.†††, ††, † represent the significance of the difference in coefficients across Pre and Dur columns at the 0.01, 0.05, and 0.10 level, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
	Pre	Dur	Pre	Dur	Pre	Dur
I(Negative)*I(Pilot)	0.010	−0.075***	−0.006	−0.078***	0.000	−0.102***
	(0.28)	(−2.65)††	(−0.15)	(−2.77)†	(0.00)	(−3.42)†
I(Negative)	−0.152***	−0.161***	−0.131***	−0.169***	−0.141***	−0.159***
	(−6.77)	(−9.60)	(−6.39)	(−10.17)	(−6.44)	(−9.02)
N	67323	77285	67318	77285	67297	77274
Date Fixed Effects	N	N	Y	Y	Y	Y
Firm FE	N	N	N	N	Y	Y
Controls	Y	Y	Y	Y	Y	Y
Main Effects	Y	Y	Y	Y	Y	Y

Table 9: **Short selling costs and flows of arbitrage capital to news sentiment-based strategies**
We follow Hanson and Sunderam (2014) and estimate the following regressio n$SIR_{im} = \beta_1 I(Decile\_news)*I(Dur)*I(Pilot)+ \beta_k X_{im} + \eta_{it}$, where SIR is the short interest ratio (in basis points) for firm i during month m. Our main variable of interest is $I(Pilot)*I(Dur)*I(Decile\_news)$. I(Pilot)*I(Dur) captures the increase in short interest for pilot firms during Regulation SHO relative to control firms. $I(Decile\_news)$ is an indicator variable equal to one if the 15-days average news sentiment over the 15 days ending on the 15th of month m for the firm is in the bottom decile of the sentiment distribution for that month, zero otherwise. Thus, β_1 captures the change in arbitrage capital allocated to a sentiment strategy for the pilot group during the experiment. We control for other standard trading strategies in column 3-5. X is a vector of controls that include the main effects; stock exchange dummies; institutional ownership; average daily turnover during the prior three months; size; trailing twelve-month return volatility; an indicator variable of whether the firm has outstanding convertible securities; and year-month fixed effects. Standard errors are clustered by year-month. ***, **, * indicates significance at the 0.01, 0.05, 0.10 level, respectively.

	(1)	(2)	(3)	(4)	(5)
	SIR	SIR	SIR	SIR	SIR
I(Pilot)*I(Dur)	0.091***	−0.128	−0.356	−0.200	−0.149
	(3.97)	(−0.77)	(−1.57)	(−0.75)	(−0.46)
$I(Decile_{news}) * I(Pilot) * I(Dur)$		0.602**	0.613**	0.578**	0.529*
		(2.04)	(2.14)	(2.01)	(1.85)
$I(Decile_{size}) * I(Pilot) * I(Dur)$			0.038	0.107	0.001
			(0.23)	(0.63)	(0.00)
$I(Decile_{MTB}) * I(Pilot) * I(Dur)$				−0.160	−0.173
				(−0.60)	(−0.68)
$I(Decile_{MOM}) * I(Pilot) * I(Dur)$					−0.616*
					(−1.81)
N	88243	57808	57808	56764	56764
R^2	0.42	0.42	0.43	0.43	0.44
Controls	Y	Y	Y	Y	Y
Year-Month FE	Y	Y	Y	Y	Y
Other-Strategies	N	N	Y	Y	Y

Table 10: **Short Selling Constraints and Abnormal Returns from Trading on News Sentiment**
This table shows the daily risk-adjusted returns (Alpha) from a news-based trading strategy for two groups (pilot and control group) for two different time periods (pre and during experiment). We use the Fama-French 3 Factors model and the Carhart (1997) four-factor model to adjust returns for the impact of contemporaneous market (Market), size (SMB), book-to-market (HML) and momentum (UMD) factors. We assemble the portfolio for the trading strategy at the close of each trading day. We form two equal-weighted portfolios based on the sign of news during the prior trading day. Negative news are articles with $CSS < 50$. We include all firms with positive news stories in the long portfolio and all firms with negative news stories in the short portfolio. We hold both the long and short portfolios for one full trading day and rebalance at the end of the next trading day. We compute all coefficient standard errors using White (1980) heteroskedasticity-consistent covariance matrix. The robust t-statistics are reporting in parentheses. ***, **, * indicates significance at the 0.01, 0.05, 0.10 level, respectively.

	(1)	(2)
	Alpha	Alpha
I(Pilot)*I(Dur)	−0.07*	−0.07*
	(−1.65)	(−1.65)
Constant	0.08***	0.08***
	(2.83)	(2.75)
I(Dur)	−0.03	−0.03
	(−0.65)	(−0.61)
I(Pilot)	0.06*	0.06*
	(1.93)	(1.93)
N	2215	2215
Controls	FF3	Cahart