Do short sellers exploit news of related firms?

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ABSTRACT

This paper provides robust evidence that short sellers have high information processing ability to exploit news of related firms. Using newly available data on firm-level customer-supplier-competitor relationships and Reg SHO daily short sales data, we find that abnormal short selling of supplier stock is negatively related to post-news customer returns, and that the relation becomes more pronounced in supplier information asymmetry. Our results show that short sellers' disproportionate trades in supplier stock on customer news are associated with lower future cumulative supplier stock returns, suggesting that short sellers are skillful in exploiting valuable trading opportunities in related firms. However, we find no significant relationship between short selling of the upstream supplier and downstream customer news in 3-party economic links, nor do we find that short sellers trade supplier stock prior to customer news announcements.

Keywords: Short Sales, News, Earnings Announcements, Customer-Supplier Relations

JEL Classification Number: G11, G23, G32

Short sellers are widely shown to be more informed than other investor types as they interpret information about the firm they short sell.[1] However, no study to date has explored whether short sellers take advantage of public information pertinent to related firms. We employ customer-supplier links as the setting to address this question. Specifically, we examine whether the perceived high information processing ability of short sellers allows them to exploit news across the supply chain to achieve profitable trades.

Cohen and Frazzini (2008) find that mutual fund managers, who are also perceived as informed traders, trade the supplier stock on customer news only if they have stockholdings in both the customer and the supplier, but trade the supplier stock with a significant lag to customer news if they only hold the customer stock. Such a finding underscores the inability of one type of informed investors to take advantage of information transfers across the supply chain in a prompt manner. In a similar fashion, Cohen and Lou (2012) examine how the same piece of information affects firms that necessitate straightforward information processing (i.e., stand-alone firms) versus their complex-to-analyze counterparts (i.e., conglomerate firms), and show significantly greater return predictability in the conglomerate firms. It is plausible to view short sellers' information processing in customer-supplier relationships versus non-linked firms (i.e., of the firm itself rather than of related firms) in a corresponding fashion to that of Cohen and Lou's complex versus easy-to-understand firms, thereby potentially suggesting short sellers' inability to process information pertinent to related firms.

We posit that short sellers take advantage of public information transfers along the supply chain to exploit profitable trading opportunities and expect that supplier short selling to be strongly associated with post-news customer returns. This research pursuit is important as it explores a channel through which short sellers could increase stock price efficiency in financial markets.

Our analyses focus on the following four related issues. First, we examine the contemporaneous relation between customer news announcement returns and supplier short selling. Our study employs (i) Reg SHO short sales transaction-level data, aggregated to the daily level, for the period January 3, 2005 to July 6, 2007; (ii) the newly available unique Factset Revere database that

[1] See Drake, Rees, and Swanson (2011) and Reed (2013).

provides information on firm-level networks of customers, suppliers, and competitors; and (iii) the Ravenpack database for all corporate non-earnings news and Compustat for earnings news release dates. Our sample contains 2,402 (2,680) supplier firms and 2,061 (2,898) customer firms in Ravenpack (earnings) news sample, 11,477 customer-supplier relations with customer non-earnings news and 19,576 customer-supplier links with customer earnings news.[2] Such a large sample offers an opportune platform to examine the link between post-news customer returns and supplier short selling. Motivated by prior studies showing that information asymmetry enhances return predictability, we also assess whether the established relation between customer news announcement returns and supplier short selling varies with the level of supplier information asymmetry. Second, we evaluate whether supplier short selling on customer news predicts lower future returns on supplier stock. Third, we explore whether the link between post-news customer returns and supplier short selling extends across the entire supply chain and examine customer-supplier information transfers (i) to the supplier industry as well as (ii) to upstream supplier-downstream customer settings for 3-party links inclusive of upstream supplier, midstream firm, and downstream customer. Finally, we investigate whether short sellers trade supplier stock prior to, rather than at or immediately after the customer news, thereby offering insights into the potential use of private information by short sellers when making trades pertinent to customer-supplier relations.

We establish a strong negatively significant relationship between post-news customer returns and supplier short selling, while incorporating the various measures that have been previously shown to relate to short selling, as well as supplier firm-year, firm-month, or industry-year fixed effects. This evidence implies that short sellers take advantage of customer news revelation to undertake profitable supplier trades, thereby exhibiting a superior information processing ability in customer-supplier settings. Our findings are robust to alternative measures of short selling (i.e., abnormal short selling and relative short selling), several return windows around the announcement dates, and across both the customer non-earnings news sample constructed from Ravenpack and the customer earnings news sample from Compustat.

[2]The Ravenpack news database also includes corporate earnings news, but to maintain consistency with the existing literature (see, for example, Christophe, Ferri, and Angel (2004)), we obtain customer earnings news announcement dates from Compustat while customer non-earnings news from Ravenpack.

We then explore whether the relationship between customer news announcement returns and supplier short selling varies with supplier information asymmetry. Prior studies show that information asymmetry results in more gradual information dissemination, thereby suggesting an increased return predictability.[3] We test whether short sellers are able to exploit information across the supply chain to a larger extent in instances of higher potential return predictability due to lower information transparency. We utilize several information asymmetry measures and find robust evidence that the link between post-news customer returns and supplier short selling strengthens in supplier information asymmetry, when high information asymmetry is captured by the low number of supplier news articles, low supplier institutional ownership, and low number of analysts covering the supplier. The results therefore suggest a role of supplier information asymmetry in short sellers' ability to take a greater advantage of the customer information for profitable supplier trades. Our evidence suggests that supplier short selling in response to customer news generates negative future supplier stock returns, thereby indicating that short sellers have the superior ability to process public information of related firms to achieve profitable trades.

To further address the robustness of our tests, we employ a multitude of filters to mitigate the possibility that our established link between post-news customer returns and supplier short selling could be driven by confounding events, especially by supplier rather than customer news, and obtain consistent results. We also design samples that capture a change in a customer-supplier relationship from linked to delinked and vice versa. Our analysis uncovers evidence of a significant relationship between post-news customer returns and supplier short selling in the linked sample (i.e., firms that establish a customer-supplier relationship after no such relationships in the prior year), but finds no significant relationship in the delinked sample (i.e., firms with no customer-supplier relationship although such a relation existed in the previous year). Further, we identify all supplier and all customer competitors in each customer-supplier pair, and construct two samples by matching (i) each customer to pseudo supplier, and (ii) each supplier to pseudo customer by industry, closest size, and book-to-market characteristics. We find no significant relationship between customer news announcement returns and supplier short selling in such pseudo customer-supplier settings. These

[3]For instance, Brennan, Jegadeesh, and Swaminathan (1993); Badrinath, Kale, and Noe (1995); Alldredge and Cicero (2015).

sensitivity tests mitigate the possibility that the documented link captures other effects. Instead, they provide further support to our main hypothesis as they suggest a robust relationship between post-news customer returns and supplier short selling.

We also ascertain whether the established link between customer news announcement returns and supplier short selling manifests extensions across the entire supply chain. We do so by undertaking two tests. In the first test, we identify supplier closest and most distant rivals in each customer-supplier pair, and examine whether information transfers in customer-supplier links propagate to supplier industry. In the second test, we identify 3-party links focusing on upstream supplier, midstream firm, and downstream customer, and examine whether downstream customer news bears any role for upstream supplier short selling. Results show evidence of increased supplier closest rival's short sales based on customer negative news announcement returns, even though the rival is not the customer's supplier, while no relation of downstream customer news to upstream supplier short selling. Finally, we examine whether short sellers have the ability to anticipate customer news, but find no evidence of supplier short selling prior to public releases of customer news.

This research contributes to the extant literature in several directions. First, to the best of our knowledge, this study is the first to test whether short sellers process information of related firms to undertake profitable trades. Specifically, we provide insights into the information intermediary role of short sellers in customer-supplier relationships. One strand of literature presents strong evidence of short sellers' superior information processing ability (e.g., Boehme, Danielson, and Sorescu, 2006; Diether, Lee, and Werner, 2009; Drake, Rees, and Swanson, 2011; Reed, 2013), while another documents significant return predictability across assets in various contexts, inclusive of the supply chain links (e.g., Cohen and Frazzini, 2008; Menzly and Ozbas, 2010). We add to these strands of literature by showing that short sellers exhibit superior information processing skills by exploiting news of customer firms to undertake profitable trades of supplier firms. This finding underscores a channel through which short sellers play an important role in the financial markets to enhance price efficiency.

Second, our study contributes new evidence regarding information transfers from customer-

supplier pairs across the supply chain. Barrot and Sauvagnat (2016) examine firm-level shock propagation in production networks and find that the negative effects on sales growth spill over to supplier rivals. The research on information propagation from customer-supplier links to other industry firms is otherwise limited. Our work therefore sheds light in this regard by providing evidence that short sellers process customer-related information to undertake profitable trades not only of the supplier firm but also of the supplier rival firm, which itself is not the supplier. We also show no evidence of the role of information transfers for short selling between the two most distant nodes across the supply chain – upstream suppliers and downstream customers. It is noteworthy that the pursuit of the above issues addresses the call for this research inquiry by Dietrich (2011), who claims the importance of producing evidence "whether information externalities extend beyond supplier-customer relationships to other firms" as such knowledge would enhance the understanding of cross-sectional correlation among firms.

Third, we add to studies that focus on short sellers' use of private versus public information for undertaking profitable trades. Christophe, Ferri, and Angel (2004), Christophe, Ferri, and Hsieh (2010), Boehmer, Jones, and Zhang (2015) demonstrate that short sellers exploit private information to trade prior to earnings announcements and analyst downgrades. Likewise, Karpoff and Lou (2010) report increased levels of short selling prior to public news about a firm's financial misconduct. Instead, Engelberg, Reed, and Ringgenberg (2012) focus on the large database of all corporate news and report that short sellers trade based on public information. We contribute to this research by underscoring that short sellers do not trade supplier stock prior to customer news announcements, thereby providing evidence of public information use for profitable trades in customer-supplier settings.

Fourth, the opposing strands of literature highlight that (i) public information disclosure results in leveling of information across traders, thereby diminishing return predictability and the prospect of abnormal return generation (e.g., Diamond and Verrecchia, 1987; Korajczyk, Lucas, and McDonald, 1991; Tetlock, 2010), or that (ii) differing information processing abilities across investors increase return predictability upon public information revelation (e.g., Harris and Raviv, 1993; Rubinstein, 1993; Kim and Verrecchia, 1994; Kandel and Pearson, 1995). We provide evidence in this

debate by offering support to the latter literature strand, as we show that the customer news announcement return is related negatively to supplier short selling in a contemporaneous setting. We show that public information disclosures allow short sellers an opportunity to undertake profitable trades, and that the magnitude of the effect increases in supplier information asymmetry.

Finally, our study adds to the literature that employs transaction-level short sales data, as opposed to monthly short interest data, thereby increasing the power of our tests that focus on short time frames of customer returns around news announcements versus those of supplier short selling. Also, we advantageously exploit the Factset Revere database of firm-level relationships detailing the information pertinent to the firm's customers, suppliers, and competitors. The benefits of this database, as opposed to Compustat segment database commonly employed in earlier customer-supplier studies, are that (i) it assigns company identifiers, thereby avoiding manual confirmation of firm names, necessitated with Compustat data, and therefore increases data accuracy; (ii) it provides information of both small and large suppliers' customers, while Compustat contains information of suppliers' major customers, as well as (iii) offers information on sector overlap with rivals.

The remainder of the paper is organized as follows. Section I discusses the motivation of our study and presents a number of testable hypotheses. Section II describes the data sources, the sample, and incorporates descriptive statistics. Section III presents the multivariate tests for the relationship between post-news customer returns and supplier short selling. It also conducts the sensitivity analyses and presents the tests of all the remaining hypotheses. Section IV concludes.

I. Motivation and Hypotheses Development

A. Short Selling based on Information of Related Firms

Existing studies have demonstrated that short sellers tend to be more informed than other types of traders.[4,5] Two related strands of literature arise in support of this argument. One body of

[4]For example, Drake, Rees, and Swanson (2011); Reed (2013).

[5]Diamond and Verrecchia (1987) posit that in light of short selling costs, short positions represent informed traders thereby implying that short sellers must exhibit strong views that prices will soon fall and thus engage in respective trades.

work documents that short selling is linked to a firm's various fundamentals, such as accruals (e.g., Hirshleifer, Teoh, and Yu, 2011), and book-to-market values (e.g., Dechow et al., 2001; Geczy, Musto, and Reed, 2002). Also, the prospect of short selling as well as short selling itself facilitates public discovery of financial misconduct (e.g., Karpoff and Lou, 2010; Fang, Huang, and Karpoff, 2016). Another line of research underscores that short selling is related negatively to future returns (e.g., Desai et al., 2002; Boehme, Danielson, and Sorescu, 2006; Boehmer, Jones, and Zhang, 2008; Diether, Lee, and Werner, 2009). Further, Drake, Rees, and Swanson (2011) report that short sellers facilitate, while analysts hinder price discovery. Boehmer and Wu (2013) find that greater shorting flow accelerates price discovery process. Massa et al. (2015) show that short selling increases the speed of information transmission by encouraging insiders to trade faster to prevent competition from short sellers.

Even though the above studies establish the information intermediary role of short sellers, it is *a priori* unclear whether and how short sellers are able to take advantage of information of related firms. We argue that short sellers' information processing pertinent to related firms versus to the firm itself is analogously to that of Cohen and Lou's (2012) complex firms versus straightforward firms. Cohen and Lou report that return predictability is stronger in the former than in the latter. Similarly, Cohen and Frazzini (2008) show that mutual funds, which are broadly viewed as a group of informed investors, trade the supplier firm's stock on the customer firm's shock only if they hold both firms in the portfolio, but fail to trade the supplier firm's stock without a substantial lag to a customer shock in the instance of only holding the customer's stock.

We therefore employ customer-supplier links as the setting to test whether short sellers are skilled to take advantage of public information of related firms when making their trade decisions and to achieve profitable trades. It is conceivable that information transfers in customer-supplier relationships are salient as these relationships are subject to common economic shocks (e.g., Cohen and Frazzini, 2008; Menzly and Ozbas, 2010; Pandit, Wasley, and Zach, 2011). Specifically, one would expect the supplier-customer pair to be affected by a particular shock as long as the customer is an important source of the supplier's current and future sales, and respectively, of its earnings

and cash flows.[6] Olsen and Dietrich (1985) ascertain vertical information transfers along the supply chain, especially between retail chain stores and their suppliers, and Pandit, Wasley, and Zach report that such vertical information transfers enhance in the magnitude of news, and especially so of the negative news announcements, as well as the strength of the economic relationship of a customer-supplier pair. Cen, Hertzel, and Schiller (2017) find that information transfers from customer to supplier stock returns are more rapid when analysts dual-cover, brokerage firms dual-cover, and institutional investors cross-invest in the supplier and its principal customer. Broadly, these studies demonstrate an existence and an important role of information transfers in economically linked relationships.

We thus form expectations pertinent to the relationship between short selling of the supplier firm's stock and the news announcement of its customer firm. We expect that since short sellers are perceived as traders with the strong information processing ability, they pay attention to market signals about the customer firm and trade the supplier stock when they consider that the market may not fully recognize the effects of the customer's news event. We also argue that high information asymmetry of supplier firms increases short selling of their shares upon their customer firms' negative news announcements as strong information processing ability of short sellers allows them to recognize the chance to capture benefits of slow information transmission into prices. These expectations lead to our following hypothesis:

HYPOTHESIS 1: *Contemporaneous short selling of a supplier firm's stock is negatively related to a customer firm's post-news announcement return and is more pronounced in supplier firms with greater information asymmetry.*

A corollary hypothesis is that short sellers, who pay close attention to information transfers along the supply chain, could take advantage of information revelation and profit from their trades, as follows:

HYPOTHESIS 2: *Supplier short selling based on its customer firm's corporate news announcements predicts future supplier stock returns.*

[6] In addition, both firms could be affected by market prices of their inputs and outputs.

B. Supplier Rival Firm's Stock and Short Selling

Prior literature reports the spillover effects of news announcements or of common shocks in a customer-supplier link to supplier rivals in various settings. For instance, Shahrur (2005) focuses on the wealth effects of horizontal mergers in customer and supplier industries, and reports positive abnormal returns of rivals of the merged firms. Fee and Thomas (2004) examine upstream and downstream effects of the horizontal mergers and offer similar evidence.[7] Focusing on firm-level shock propagation in production networks, Barrot and Sauvagnat (2016) show that the adverse effects on sales growth are more pronounced when the affected supplier is more difficult to replace, and also find evidence of spillover of these effects to supplier rivals.

We are thus interested in assessing whether customer news announcements form the views of short sellers not only regarding the supplier firm but also those pertinent to supplier rivals. The pursuit of this issue addresses the call for such inquiry by Dietrich (2011) who asserts that it is important to provide evidence "whether information externalities extend beyond supplier-customer relationships to other firms in the supplier's industry" as such findings could deepen the understanding of cross-sectional correlation among firms. Specifically, we expect the information externality of the customer-supplier link to exhibit an effect on the supplier rival, especially if the supplier and rival firms operate in a larger number of common sectors as such an occurrence manifests a stronger interconnectedness of their business operations and the resulting financial success. Alternatively, supplier rival firms could be unaffected by customer firm news announcements, provided the supplier's and supplier rival's business lines do not overlap substantially. The implications above lead to our hypothesis as follows.

HYPOTHESIS 3: *Contemporaneous short selling of a supplier's rival firm's stock is negatively related to post-news customer returns, especially when the supplier firm and rival firm overlap substantially in the industries they operate.*

[7]Specifically, they find that rivals of the merged firms experience positive abnormal returns at horizontal merger announcements, but show no negative abnormal returns in mergers facing antitrust concerns. The authors interpret that the rival's shares could increase in value on a merger announcement as either the financial markets perceive that the firms within the industry are undervalued, or they could rise on the prospect of the benefits from their own subsequent mergers.

C. *3-Party Economic Links and Short Selling*

While finance research on supply chain relationships predominantly examines customer-supplier pairs (i.e., 2-party links), a few studies explore the various effects across the supply chain; that is, they concentrate on upstream supplier-midstream firm-downstream customer relationships (3-party links). For instance, Fee and Thomas (2004) examine the effects of horizontal mergers on the merged firms, its upstream suppliers, or downstream customers.[8] Shahrur (2005) employs input-output accounts to identify downstream and upstream industries, and examines the wealth effects of horizontal mergers on firms in these industries.[9]

The strength of the economic relationship in 2-party links is more apparent as long as, for instance, the customer comprises a meaningful proportion of supplier's sales revenue, and thus of its earnings and cash flows. However, the strength of the relationship between the downstream customer and upstream supplier as well as their mutual dependence, is less clear. Likewise, the common economic shocks could either exhibit no impact on the downstream customer-upstream supplier relationship, or affect the 3-party link in a manner different from that prevailing in 2-party links.

We build on the assumption that the effects of the well-documented relationship between customers and suppliers in 2-partly links could extend to a 3-party link, where the downstream customer's financial health is correlated not only with its supplier's (midstream firm's) financial condition, but also with its supplier's supplier (i.e., upstream supplier) financial standing. In this setting, one could expect that short sellers not only interpret the role of the customer's news event for its supplier's future returns, but also do so for the upstream supplier's subsequent performance. Such a prediction leads to our following prediction.

HYPOTHESIS 4: *Contemporaneous short selling of an upstream supplier firm's stock is negatively related to a downstream customer firm's post-news announcement returns.*

[8]The authors report (i) merger gains as well as positive abnormal returns for the merged firms at merger announcements; (ii) insignificant stock price reactions and little effects on subsequent operating performance of customers in upstream mergers; and (iii) negative announcement returns and reductions in cash flows to sales of suppliers in downstream mergers, which are more pronounced in supplier dependence on the merged firms for revenues.

[9]The author reports positive abnormal returns to firms in both customer and supplier industries for a subsample of takeovers with positive combined wealth effects for both bidder and target shareholders, while negative abnormal returns to firms in supplier industries outside of this subsample.

D. Public versus Private Information of Supplier Short Selling

Recent literature uncovers the use of both private and public information by short sellers to generate superior returns. For instance, Christophe, Ferri, and Angel (2004), Christophe, Ferri, and Hsieh (2010), and Boehmer, Jones, and Zhang (2015) report evidence of increased short selling *prior* to earnings announcements and to analyst downgrades, thereby inferring that short sellers are informed investors with private information. Similarly, Karpoff and Lou (2010) report increased levels of short selling *prior* to public news about a firm's financial misconduct. In contrast, focusing on a large database of all corporate news events, Engelberg, Reed, and Ringgenberg (2012) report evidence of profitable short selling on news days, suggesting that short sellers exploit public rather than private information to undertake profitable trades.[10]

Two opposing strands of extant literature help explain the above conflicting findings. On the one hand, studies suggest that to generate superior returns, one must likely take advantage of private information as with public information revelation, an opportunity for profitable trades dissipates.[11] On the other hand, a line of research proposes that public information may allow carrying out profitable trades as long as the trader possesses a superior ability to process this publicly available information.[12]

We therefore conjecture that short sellers exploit news to make profitable trades of supplier firms based on their customer firms' news events as information processing in a customer-supplier link could be more complex than outside of the supply chain relationship (i.e., the interpretation of a firm's own information for short selling of its own shares) (e.g., Cohen and Lou, 2012). Interestingly, Alldredge and Cicero (2015) report that even company insiders, usually expected to exploit private information, take advantage of public information pertinent to customer-supplier links, to undertake

[10]The authors further interpret that the superior information processing ability of short sellers provides an opportunity for profit generation based on public news announcements.

[11]Diamond and Verrecchia (1987) and Korajczyk, Lucas, and McDonald (1991) report that news reduces information asymmetry. In line with the above studies, Tetlock (2010) finds that public information revelation aligns available information for investors with access to private information with those without such an access, and also shows no evidence that news interpretation varies by trader type.

[12]Harris and Raviv (1993) and Kim and Verrecchia (1994) develop information asymmetry models, with traders who receive common signals but differ in their abilities to interpret these signals. In a similar fashion, Rubinstein (1993) and Kandel and Pearson (1995) suggest that public news could provide an opportunity for profitable trades for investors with superior information processing ability since different traders could interpret the same news story differently.

profitable trades. It is important to emphasize that the scope of this study is not to rule out the use of private information by short sellers. We are interested in ascertaining whether short sellers mainly employ public information when they trade by exploiting information transfers across the supply chain. Our arguments give rise to the following hypothesis:

HYPOTHESIS 5: *Short sellers rely on public information when they trade a supplier firm's stock based on its customer firm's corporate news announcements.*

II. Data and Sample Construction

We construct our sample from several data sources: (i) economic links from Factset Revere, which is made available via the Wharton Research Data Services (WRDS); (ii) customer non-earnings news from Ravenpack and customer earnings announcement dates from Compustat, both available via WRDS; (iii) short-selling information from NYSE Trade and Quote (TAQ) data, various stock exchanges' websites, and Regulation SHO (Reg SHO) database; (iv) control variables from Compustat and CRSP. The definitions of all the key variables are depicted in Appendix A.

A. Economic links

Factset Revere offers a unique database of company-level relationship information and specializes in collecting publicly disclosed information about a firm's network of customers, suppliers, competitors, and geographic exposures, starting in 2003. Its public sources include corporate quarterly and annual filings (e.g., 8-K, 10-Q, and 10-K), investor presentations, websites, and press releases. One advantage of the Revere data is that they contain information of both major and minor private and publicly-listed customers, as well as their identities.[13] Under Regulation SFAS No. 131, firms are required to disclose the identity of any major customer that represents at least 10% of the firms' total reported sales. Unlike Factset Revere, the Compustat Segment Customer data, which are commonly employed in previous studies, obtain the supply chain relationship information only from companies' annual 10-K fillings and hence, contain a revenue distribution of firms' major customers. A critical shortcoming of Compustat is that it does not assign company identi-

[13]For publicly-listed customers, the identities are unique Compustat's GVKEYs that allow us to link the Factset Revere data to Compustat and CRSP databases.

ties (GVKEYs) to publicly-listed customer firms, whose names are as reported in the original filing and are abbreviations or even subsidiary names. To circumvent these data issues, one needs to manually check and identify each customer firm before she could merge the Compustat information with other databases. Importantly, however, to avoid any missed records in Factset Revere, we also complement our customer-supplier links data from Revere with a subset of Compustat Segment Customer data in which customers are matched to GVKEY through a fuzzy name algorithm and verified manually.

To illustrate the information contained in the Factset Revere database, Figure 1 shows a 2007 snapshot of Google with its reported suppliers, rivals, and partners. Google has 32 upstream suppliers, 72 rival firms, and 45 partners. In 2007, Google represented 14.5% of Conversant's sales. Based on the Factset Revere data, Yahoo and Answers.com are the closest rivals to Google in that these rivals and Google overlap substantially in the number of sectors they operate in.

We then merge the Factset Revere information with other databases, as described below. Even though our Factset Revere data span from 2003 to 2015, our sample period is constrained by the availability of Reg SHO's short-selling data, which is only available from January 3, 2005 to July 6, 2007. We also form two samples of customer-supplier links based on the types of customer news; one sample is based on customer non-earnings news from the Ravenpack database and the other uses earnings announcement dates from Compustat. By analyzing separate samples of customer news, we are able to determine the relative impact of earnings news, one of the most important corporate news, compared to that of customer non-earnings news. Table 1 shows the summary statistics of our samples formed using Ravenpack non-earnings news and Compustat earnings releases. Our final sample of customer non-earnings news consists of 2,402 supplier firms, 2,061 customer firms, and 11,477 customer-supplier links with non-earnings news. On the other hand, the earnings news sample contains 2,680 supplier firms, 2,898 customer firms, and 19,576 customer-supplier links with corporate earnings news. The mean (median) number of suppliers per customer is 5.566 (2) for the non-earnings sample, compared with 6.753 (2) for the earnings news sample. The corresponding mean (median) numbers of customers per supplier are 4.776 (3) and 7.303 (4).

B. Customer News

Ravenpack is a major news analytics provider that offers real-time structured sentiment, relevance, and novelty data for entities and events detected in unstructured text published by reputable sources, including newswire contents from Dow Jones and the Wall Street Journal and web content from thousands of online sources. Ravenpack analyzes and processes entity-specific news releases and generates entity-specific relevance, novelty, and sentiment numerical scores to all events in news articles. A relevance score ranging from 0 to 100 is assigned to capture the relevance of an entity-specific news, with 100 (0) signifying most (least) relevance. We employ all non-earnings news from Ravenpack. For consistency with extant studies, we obtain earnings announcement dates of firms from Compustat.

To ensure that our results are not driven by potential confounding events, we mitigate this possibility by undertaking the following filters in our customer non-earnings news sample and earnings news sample throughout the study. Specifically, we remove observations with overlapping or multi-firm news as follows: (i) the news must not have any counterparts in the previous day and the following two days around the announcement date; (ii) the supplier's earnings announcement must not take place during the two trading days around the customer's earnings announcement; (iii) the news is the only fresh news of a particular kind in the 24-hour time frame; (iv) customer firm is the only relevant company in the news (Ravenpack score of 100 for both relevance and event novelty); (v) customer firm must have no more than one news in a given day (e.g., days which include 1 positive news and 2 negative news are removed). Such filters help increase the power of our tests by ensuring a more accurate measurement of short selling in response to specific news as certain investors may not recognize the degree to which other traders have already employed particular information when making decisions about their trades, causing these investors to confuse stale and fresh news (Tetlock, 2011).

The summary statistics are shown in Table I. On average, each customer-supplier link has 5.649 non-earnings news articles provided by Ravenpack and 7.594 earnings news releases from Compustat. Their medians are 6 and 5, respectively. In total, we have 52,451 customer-supplier pair year observations in the non-earnings news sample, and 89,328 in the earnings news sample.

The smaller number of economic links with customer non-earnings news in the former is due to our above-mentioned stricter selection criteria employed in constructing the sample.

C. Short-Selling Data

In June 2004, the SEC implemented Reg SHO under the Securities Exchange Act of 1934 to assess short sale practices. Under Reg SHO, all transaction-level short sales data between January 3, 2005 and July 6, 2007 were made available to the public. We collect the short-sale information on stocks traded on nine different exchanges, namely the NYSE Trade and Quote (TAQ) database and from the websites of the American Stock Exchange, National Association of Securities Dealers Automated Quotations, National Stock Exchange, Archipelago, Boston Stock Exchange, Chicago Stock Exchange, National Association of Securities Dealers, and Philadelphia Stock Exchange.[14] The short-sale information includes the stock ticker, the number of shares shorted, the transaction date and time, and short-sale price. We aggregate the short-sales transaction data to the daily level by ticker symbol, trading date, and the stock exchange on which the stock is traded, and then merge the daily data with CRSP daily data by ticker and date.

We define a customer firm's news release date as the date that Ravenpack first reports the news, or that Compustat reports the earnings announcement. Throughout the study, we set the customer news release date to day 0. Following Christophe, Ferri, and Angel (2004) and Henry and Koski (2010), we compute abnormal short-selling around customer news release dates, AbSS(0,T), which is the difference between the average daily number of a supplier firm's shares sold short during the days following customer news release day 0 to day T and the average daily number of the firm's shares sold short during the non-announcement period, and the difference is then normalized by the the average daily number of the firm's shares sold short during the non-announcement period. The non-announcement period is the period within the quarter that the news is released, but excludes days from day 0 to day T. In the case of earnings announcements, the non-announcement period is measured between day -57 and day -5 from the announcement date set at day 0.[15] In the case of Ravenpack news, the non-announcement period is measured within each quarter but excluding

[14] See Massoud, Saunders, and Keke (2011) for more details of the data.

[15] We also define the non-announcement period to be from T (T=2, 5) of the previous quarter (announcement date) to -1 from the current quarter (announcement date) and find the results to be qualitatively similar.

day -5 to day +5, where day 0 is the news release day.[16] Our analyses focus on AbSS(0,2) and AbSS(0,5). As an illustration, we show below the timeline for computing AbSS(0,5).

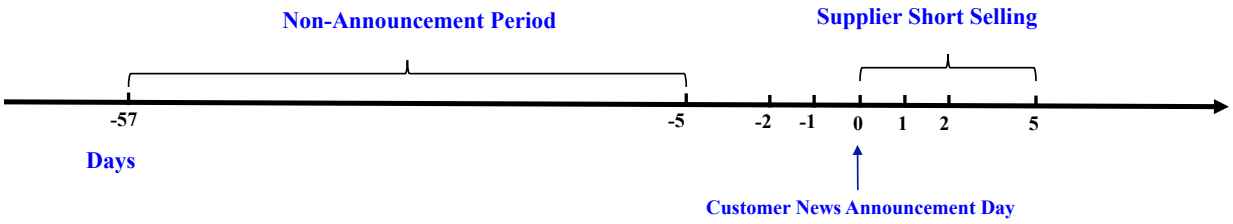

Figure 1: Timeline for Computing AbSS(0,5)

Table I shows a negative mean AbSS(0,2) for the Ravenpack news sample, but a positive AbSS(0,2) for the earnings news sample and positive AbSS(0,5) for the two samples. The respective median values are all negative during the sample period. Inferring from the large standard deviation values such as 64.07%-74.16%, there is a substantial cross-sectional variation in AbSS(0,2) and AbSS(0,5).

D. Control Variables

Throughout the analysis, we control for several variables that can potentially influence abnormal short selling of a supplier's stock. Their statistics are also shown in Table I. Our analysis includes abnormal volume of supplier shares traded (AbVol^S) during the days that correspond to the period of abnormal short selling (AbSS), our key dependent variable. Similar to that of the AbSS, the standard deviations of both measures of $\text{AbVol}^S(0,2)$ and $\text{AbVol}^S(0,5)$ are substantially larger than their mean and median values. To ensure that the abnormal supplier short selling is not triggered by the supplier's own return performance or by the market performance, we include both these variables (Ret^S and Ret^M) in all our regressions. Finally, we control for the supplier's firm size and book-to-market equity ratio.

Table II reports the Pearson cross-correlation matrix of the customer non-earnings news sample as its correlation matrix is qualitatively similar to that of the earnings sample. The correlation coefficients between customer return $\text{Ret}^C(0,2)$ and supplier short selling measures (i.e., AbSS(0,2) and

[16]The results remain materially unchanged if the average daily number of a firm's shares sold is computed throughout the sample period, but excludes days used to compute AbSS(0,2) and AbSS(0,5).

AbSS(0,5)) are negative and highly statistically significant. While these correlations are consistent with our prediction, they are based on univariate analyses and hence do not take into consideration other variables that may possibly drive their correlations. In subsequent sections, the multivariate analyses control for such variables. We find that the abnormal volume of supplier shares is an important determinant of supplier short selling; its correlation with abnormal short selling is between 0.633 and 0.737 for $\text{AbVol}^S(0,2)$ and from 0.608 and 0.765 for $\text{AbVol}^S(0,5)$. The coefficients are all highly statistically significant at the 1% level. Except for own correlation with different window specifications (for example, $\text{Ret}^M(0,2)$ and $\text{Ret}^M(0,5)$), the correlation coefficients of all control variables are less than 0.5, suggesting no evidence of multicollinearity in the regression models.

III. Empirical Results

A. Baseline Results

In this subsection, we test our first hypothesis of the relationship between customer news announcements and supplier abnormal short selling. Specifically, we regress the supplier firm's abnormal short selling measure, $AbSS^S(0,T)$, on the key explanatory variable – its customer firm's 2-day announcement return, $Ret^C(0,2)$, while controlling for firm-specific measures that have been shown by the extant literature to relate to short selling, as shown in the model below.

$$\begin{aligned} AbSS^S(0,T) &= a_0 + a_1\text{Ret}^C(0,2) + a_2\text{AbVol}^S(0,T) + a_3\text{Ret}^S(0,T) + a_4\text{Ret}^M(0,T) \\ &\quad + a_5\text{Size}^S + a_6\text{BM}^S + \epsilon \end{aligned} \tag{1}$$

We follow Christophe, Ferri, and Angel (2004) and Henry and Koski (2010) to construct the abnormal short selling metric, $AbSS^S(0,T)$, which has been described in greater detail in the previous subsection. We employ the key explanatory variable, $Ret^C(0,2)$, to convey earnings surprise since a positive (negative) return implies that the market perceives a particular news announcement in a favorable (an unfavorable) manner. Equation (1) is the baseline regression, and if Hypothesis 1 is correct, the a_1 coefficient should be negatively significant, thus underscoring higher short selling of a supplier firm's shares upon negative market's perception of the customer news announcement.

Based on the extant literature, we control for the market return ($Ret^M(0,T)$), supplier size

($Size^S$), and supplier book-to-market equity ratio (BM^S) (e.g., Desai et al., 2002; Christophe, Ferri, and Angel, 2004; Alldredge and Cicero, 2015). We also account for the average share turnover during day 0 to day T of the supplier firm as a proportion of traded shares during the non-announcement period ($AbVol^S(0,T)$) to incorporate the possibility that firms exhibiting sudden volume increases could be easier to short as well as for the prospect of the relation between abnormal short sales and volume surges. Finally, we control for the supplier return ($Ret^S(0,T)$) to corroborate that the link between $AbSS^S(0,T)$ and $Ret^C(0,2)$ does not merely capture the role of supplier's own returns in supplier short selling as sudden supplier stock price changes could affect short sellers' decisions pertinent to supplier firms (e.g., Christophe, Ferri, and Angel, 2004; Cohen and Frazzini, 2008). Throughout the study, all our multivariate analyses account for supplier firm-year and for industry-year fixed effects (as applicable) and all associated t-statistics are computed based on standard errors adjusted for the supplier firm clustering. In unreported tests, we account for firm-month fixed effects in lieu of the market return, and obtain unaltered results.

Estimates of (1) are contained in Table III. Models 1-6 of Panel A focus on all corporate non-earnings news announcements as it offers a broad platform to ascertain whether and how customer post-news announcement returns relates to supplier contemporaneous short selling across all corporate news types. Such an approach allows drawing strong inferences about the short sellers' actions pertinent to information externalities associated with customer-supplier links. To provide further robustness of our tests, we also separately examine earnings announcements in Models 7-12 of Panel A as earnings news is recognized as one of the most important corporate news and is a large news category. For example, Tetlock (2014) reports that earnings announcements comprise 33% of newswires. To examine whether the observed effects vary with the length of time window around the customer news announcement date, we focus on two time periods. Specifically, we examine the time period from the announcement date (day 0) through the second day after the announcement (day 2), and present the results in Models 1-3 and 7-9 of Panel A for the customer non-earnings news and customer earnings news, respectively. We also report the results from the announcement day through the fifth day after the announcement, or time period (0,5) in Models 4-6 (non-earnings news) and Models 10-12 (earnings news) of Panel A. For each time period and

each news sample, we perform two regressions, without (i.e., Models 1, 4, 7, and 10) and with the inclusion of the key explanatory variable, $AbSS^S(0,T)$ (i.e., Models 2-3, 5-6, 8-9, and 11-12).

To verify that our results are not driven by the choice of the abnormal short selling measure, $AbSS^S(0,T)$, we follow Christophe, Ferri, and Angel (2004) and Henry and Koski (2010) and also perform the same tests on an alternative short selling metric, the relative short selling ($ReSS^S(0,T)$), and present the results in Table III, Panel B, across 12 models. These models are constructed analogously to those in Panel A. $ReSS^S(0,T)$ measures relative short selling, computed as the ratio of supplier's shorted shares to traded shares for the customer's announcement time period (0,T). To control for the volume associated with $ReSS^S(0,T)$, we replace $AbVol^S(0,T)$ with $NReSS^S(0,T)$, which is the number of shorted shares to traded shares during the non-announcement period. In all subsequent tests, we employ both short selling measures, $AbSS^S(0,T)$ and $ReSS^S(0,T)$, but only report the results with the former metric as employing the latter measure renders virtually no impact on our findings.

The results in Table III are consistent with Hypothesis 1 as the coefficients of $Ret^C(0,2)$ are strongly negatively significant across all models in both Panels A and B. For example, the coefficient of $AbSS^S(0,T)$ in Model 2 of Panel A is -0.652 and is significant at the 1% level, thus highlighting close to 0.7% increase in supplier abnormal short selling upon customer's negative announcement returns. In terms of economic significance, a one-standard deviation decrease in $Ret^C(0,2)$ is associated with a 2.065% increase in abnormal short selling. It is important to stress that although the regression coefficients of $AbSS^S(0,T)$ and of $ReSS^S(0,T)$ are strongly significant in all models at the 1% level, the magnitudes of the coefficients in (0,2) windows are larger than those in (0,5) windows. Such findings imply a stronger link immediately at and around the news release, thus confirming that short sellers exhibit high information processing skills that allow them to quickly incorporate the new information into the revision of their beliefs about a supplier firm's prospects.

The results on the control characteristics are broadly consistent with those of prior studies. Specifically, higher supplier abnormal volume and market returns relate positively and negatively to supplier abnormal short selling, respectively. Interestingly, higher supplier returns exhibit a positive link to supplier abnormal short selling. Such results are consistent with Diether, Lee, and

Werner (2008) who report increased short selling after price run-ups. The regression coefficient of supplier size is negatively significant in Panel A when the models control for industry-year fixed effects, and positively significant in Panel B when the models control for firm-year fixed effects, but that of the book-to-market equity ratio is insignificant.

We also estimate the expanded baseline model that incorporates a metric of information asymmetry, InfoAsym, and its interaction with $\text{Ret}^C(0,2)$, as given by

$$\begin{aligned}\text{AbSS}^S(0,T) = a_0 + a_1\text{Ret}^C(0,2) + a_2\text{InfoAsym} \times \text{Ret}^C(0,2) + a_3\text{InfoAsym} + a_4\text{AbVol}^S(0,T) \\ + a_5\text{Ret}^S(0,T) + a_6\text{Ret}^M(0,T) + a_7\text{Size}^S + a_8\text{BM}^S + \epsilon. \qquad (2)\end{aligned}$$

To conduct the tests, we employ binary variables to measure InfoAsym. We include (i) News, which takes the value of 1 if the supplier falls into the top quartile-ranked supplier firms with the largest number of news articles; (ii) InstOwn, which equals 1 if the supplier is in the top quartile-ranked supplier firms with the highest concentration of institutional ownership; and (iii) Analysts, which takes the value of 1 if the supplier is in the top quartile-ranked supplier firms with the most number of analysts following the firm. Accordingly, InfoAsym measures take the value of 1 in the instance of lower information asymmetry or greater transparency, and 0 if the information asymmetry is higher. Taken together, these measures provide a broad spectrum of metrics capturing a firm's information environment.

The results in Table IV highlight the regression coefficients of $Ret^C(0,2)$, those of its interaction terms with News, InstOwn, or Analysts, as well as of InfoAsym measures, presented separately across 12 models, which focus on customer non-earnings news versus customer earnings news, as well as on (0,2) versus (0,5) windows around the announcement date. The coefficients of the control characteristics are not tabulated given space considerations. The regression coefficients of post-news customer returns remain negative and strongly significant in all models. Importantly, the coefficients of the interaction terms between $Ret^C(0,2)$ and each of the InfoAsym metrics are positive and statistically significant in most models. Consistent with the results in earlier tables, the magnitudes of the coefficients of the interaction terms are all higher in (0,2) than in (0,5) windows around the announcement date. Some exceptions are the interaction terms of $Ret^C(0,2)$ with Analysts in Models 5-6, which are insignificant, while their counterparts in Models 11-12 are

highly significant. Broadly, the interactions terms of $Ret^C(0,2)$ with each of the three information asymmetry measures - News, InstOwn, and Analysts - are positive and significant. As each of these information environment metrics takes the value of 1 in the instance of lower information asymmetry, positive interaction terms bear the predicted signs and imply that the negative link between customer announcement returns and supplier short selling is more (less) pronounced in high (low) supplier information asymmetry.

In sum, we have found a strong negatively significant relation between post-news customer returns and supplier short selling, and the evidence strengthens in supplier information asymmetry.

B. Short Sales and Supplier Future Stock Returns

We next test whether supplier short selling on customer news predicts lower future returns on supplier stock. Following Bohemer, Jones, and Zhang (2008) and Engelberg, Reed, and Ringgenberg (2012), we estimate the following regression.

$$\begin{aligned} Ret^S(+t) = a_0 + a_1 \text{AbSS}^S(0,2) + a_2 \text{Ret}^M(+t) + a_3 \text{Size}^S + a_4 \text{BM}^S + a_5 \text{Volatility}^S \\ + a_6 \text{Turnover}^S + \epsilon. \end{aligned} \tag{3}$$

The dependent variable in (2) is supplier cumulative future stock return over t days, and the key independent variable is abnormal short selling AbSS(0,2) around customer news announcements. We estimate regression model (2) with supplier cumulative future stock returns of varying horizons from 10 days to 20 days subsequent to the window employed to compute AbSS(0,2), while controlling or the corresponding value-weighted market cumulative future return, supplier size, book-to-market equity ratio, as well as supplier previous month's stock volatility and turnover. The results reported in Table V show evidence that AbSS(0,2) has predictive power for supplier future stock returns and indicate that the greater the AbSS(0,2), the lower is the supplier future cumulative return. The overall results suggest that short sellers exploit news of related firms and that their trades of supplier stock on customer news are consistent with the direction of future returns.

C. Robustness Tests

C.1. Linked versus DeLinked Relationships

To further establish that the link between post-news customer returns and supplier short selling is not spurious, we conduct two additional tests. In the first test, we construct a subsample of customer-supplier pairs that are either linked and become de-linked or vice versa, during our sample period between January 3, 2005 and July 6, 2007. This subsample construction is illustrated by the following example. Marvel Entertainment Inc. and Hasbro Inc. exhibit a customer-supplier link in years 2003-2004, no relationship in 2005-2006, and are re-linked in 2007-2008. In 2009, the firms become de-linked again as Walt Disney Company acquires Marvel Entertainment for $4 billion. Therefore, during our sample period, this relationship exhibits a change from the de-linked status in years 2005 and 2006 to the linked status in 2007. It is important to highlight that customer-supplier pairs that do not experience a change in the relationship during our sample period (i.e., always linked or never linked firms) do not enter the subsample. The goal of employing the change-status subsample is to verify that short sellers' decisions to short supplier's stock are indeed driven by their knowledge of the newly (re)established customer-supplier link rather than by alternative causes.

We perform the regression analyses similar to those in our baseline model, but the key explanatory variables are Linked $\text{Ret}^C(0,2)$ and Delinked $\text{Ret}^C(0,2)$, as follows.

$$\begin{aligned} \text{AbSS}^S(0,T) &= a_0 + a_1 \text{Linked Ret}^C(0,2) + a_2 \text{Delinked Ret}^C(0,2) + a_3 \text{AbVol}^S(0,T) \\ &\quad + a_4 \text{Ret}^S(0,T) + a_5 \text{Ret}^M(0,T) + a_6 \text{Size}^S + a_7 \text{BM}^S + \epsilon. \end{aligned} \tag{4}$$

In regression model (3), Linked $\text{Ret}^C(0,2)$ equals customer's announcement returns during the (0,2) window if the customer is linked to the supplier and equals zero if otherwise, whereas Delinked $\text{Ret}^C(0,2)$ equals customer's announcement returns during the (0,2) window if the customer is delinked from the supplier and zero if otherwise. The control characteristics are the same as those in Table III.

The results contained in Table VI are consistent with our prediction that short sellers trade based on the information externality in a customer-supplier pair, and that short sellers are attentive to

the existence of customer-supplier links. Specifically, the regression coefficients of Linked $\text{Ret}^C(0,2)$ are negatively significant and are stronger in the (0,2) window, whereas they are weaker in the (0,5) window. Such differential effects are consistent with those reported in the main results of Table III. In turn, the regression coefficients of Delinked $\text{Ret}^C(0,2)$ are insignificant across all four models. Such findings suggest that short sellers take advantage of unfavorable customer news to short the supplier's stock in an active customer-supplier relationship, even if the relationship was not active in the preceding year. Short sellers make no such trades during the time period when the customer exhibits no relationship with the supplier even if such a relationship existed in the prior year.

C.2. Placebo Tests

In the second test, we adopt an alternative approach to establish that the customer-supplier relationship is indeed driving short sellers' decisions to short supplier's stock based on its customer's news announcements. We designate pseudo suppliers, $S*$, and pseudo customers, $C*$, by matching the true suppliers or customers to the pseudo suppliers or customers by industry, closest size, and book-to-market characteristics. If short sellers are indeed carrying out their trades based on the customer news releases pertinent to a customer-supplier relationship, the effect must only exist in a true customer-supplier pair and no effect should be observed in a pseudo customer-supplier link.

We assign firms to *pseudo supplier-customer* links and *supplier-pseudo customer* links, as follows:

$$\begin{aligned}\text{AbSS}^{S*}(0,T) &= a_0 + a_1\text{Ret}^C(0,2) + a_2\text{AbVol}^{S*}(0,T) + a_3\text{Ret}^{S*}(0,T) + a_4\text{Ret}^M(0,T) \\ &= +a_5\text{Size}^{S*} + a_6\text{BM}^{S*} + \epsilon. \qquad (5)\end{aligned}$$

$$\begin{aligned}\text{AbSS}^{S}(0,T) &= a_0 + a_1\text{Ret}^{C*}(0,2) + a_2\text{AbVol}^{S}(0,T) + a_3\text{Ret}^{S}(0,T) + a_4\text{Ret}^M(0,T) \\ &= a_5\text{Size}^{S} + a_6\text{BM}^{S} + \epsilon. \qquad (6)\end{aligned}$$

$AbSS^{S*}(0,T)$ in (4) denotes the abnormal short selling of a pseudo supplier's stock and $Ret^{C*}(0,2)$ in (5) represents a pseudo customer's announcement returns.

The results are reported in Table VII. Models 1-2 and 5-6 pertain to pseudo suppliers linked to true customers, and Models 3-4 and 7-8 focus on pseudo customers linked to true suppliers. The results are aligned with our prediction as none of the $Ret^C(0,2)$ coefficients is statistically

significant across all models. Since the above tests are carried out on artificial links of customers and suppliers, such evidence offers further support to the expectation that short sellers respond to customer news announcements to short supplier stock in true customer-supplier links.

In summary, this subsection provides corroborating evidence that the established link between post-news customer returns and abnormal supplier short selling is distinct and persists in various sensitivity tests, rather than spuriously displays a relationship when none exists.

D. Short Selling of Supplier Rivals' Stock and Upstream-Downstream Relationships

D.1. Supplier Rivals

In this subsection, we examine whether short sellers respond to customer news announcements to engage in trades that pertain to supplier rivals. As suppliers and certain rivals may not have correlated fundamentals, we particularly expect the link to depend on the degree of overlapped business operations between the supplier and supplier rival.

To carry out the tests, we employ Factset Revere's relationship data to locate all competitors of the supplier in each customer-supplier pair. We remove rivals that share the same customer with the supplier to ensure any observed effects are not driven by the customer-supplier rival links. We further take advantage of the Revere's "overlap" variable, which reports the number of overlapping industry sectors in each rival pair, with the sectors based on Revere's proprietary industry classification, designed to exhibit a hierarchical structure.[17] We then identify the closest and most distant rivals based on the largest and smallest numbers of overlapped sectors, respectively.

The results are displayed in Table VIII. We replicate the baseline regression (1) using the subsamples of closest and most distant rivals and present the analyses separately by rival type. We also control for customer supplier's returns. The findings indicate that the $Ret^C(0,2)$ coefficients are significantly negative for the regressions on the closest rival, but exhibit no significant effects in models pertinent to the distant rival. Importantly, the significant effect of customer news on supplier's closest rival's short selling becomes slightly weaker after we control for the customer supplier's returns, while it persists, an indication that this effect is distinct and does not merely

[17] Factset Revere has about 1400 industry classifications.

capture the link between supplier's returns and supplier rival's short selling. In terms of the economic significance of $Ret^C(0,2)$, short selling increases by 0.541% (2.065%) in the customer non-earnings news sample in column (1) of Table VIII (column (2) of Table III) per one-standard deviation decrease in $Ret^C(0,2)$, suggesting that the effect of customer news is 3.82 times greater on immediate supplier than that on the supplier's closest rival.

Overall, our findings suggest that short sellers respond to customer news announcements to short supplier rival's stock if the rival shares several industry sectors with the supplier. It is noteworthy that such results are important especially in the context of the design of the closest rival sample, where the rival is not a direct supplier of the customer. Such a sample construction results in an expectation of a weaker or no relationship compared to that with the true supplier. Instead, it appears that the relationship between the post-news customer returns and supplier rival's short selling persists even if the supplier's rival is not itself the customer's supplier. The above finding deepens our understanding of information spillovers through short selling across the supply chain to the supplier industry.

D.2. Upstream-Downstream Relationships

We now examine whether there is any link between post-news downstream customer announcement returns and upstream supplier short selling. It is plausible that the information flow in a customer-supplier relationship (where the supplier is the midstream firm) also affects the upstream supplier as the financial health of all three involved parties could be mutually determined due to interdependence of revenues, earnings, and cash flows. On the other hand, the role of the customer-supplier link may be too remote to exhibit any impact on the upstream supplier.

We identify 3-party links of upstream supplier-midstream firm-downstream customer, and remove S&P 500 firms in the midstream node. We do so for two main reasons. First, S&P 500 firms tend to have a well diversified supplier base, thus potentially rendering no crucial role of any one supplier. Second, as information asymmetry is the driving factor of return predictability, we expect high information transparency in customer-S&P 500 supplier links to make an opportunity of short sellers' profit generation pertinent to the upstream supplier less likely. The above sample construc-

tion is more likely to reveal information flow effects, if any, in the upstream supplier-downstream customer links.

We replicate the baseline regression (1) with the abnormal short selling of the supplier's supplier as the dependent variable and the upstream supplier's controls in place. The results are contained in Table IX. While the control characteristics resemble those of the main tests in Table III, the regression coefficients of the key explanatory variable, $Ret^C(0,2)$, are insignificant across all four models. Such an occurrence suggests that short sellers do not short upstream supplier's stock based on news announcements of the downstream customer. Perhaps the complexity of the multitude of midstream and upstream suppliers, all with different degrees of the strength of the direct relationships in paired links (i.e., 2-party links) render no strong information flow effects between the two most distant participants in the supply chain – upstream suppliers and downstream customers. The lack of information transfers, possibly caused by the lack of economic interdependence, results in no observed relationship between downstream customer announcement returns and upstream supplier short selling.

E. Public versus Private Information

Thus far, we postulate the use of public information by short sellers in customer-supplier links. Accordingly, the research design of our multivariate tests reflects contemporaneous settings. However, earlier literature proposes and finds results consistent with short sellers acting prior to information being publicly released, thereby suggesting that short sellers rely on private information for profitable trades (e.g., Christophe, Ferri, and Angel, 2004; Karpoff and Lou, 2010), or have the ability to anticipate news (e.g., Boehmer, Jones, and Zhang, 2008). In contrast, Engelberg, Reed, and Ringgenberg (2012) report profitable short selling based on public rather than private information. Specifically, they show that abnormal short selling forecasts significantly lower future returns on news days than on non-news days. Their evidence suggests that short sellers have superior information processing ability and are able to take advantage of profitable trading opportunities arising from news events.

In the context of the above studies, we conduct the following test. We examine whether short

sellers use private information by initiating supplier trades prior to news announcements. We adjust our baseline regression model as follows.

$$\begin{aligned}\text{AbSS}^S(-T,-t) = a_0 + a_1\text{Ret}^C(0,2) + a_2\text{AbVol}^S(-T,-t) + a_3\text{Ret}^S(-T,-t) \\ + a_4\text{Ret}^M(-T,-t) + a_5\text{Size}^S + a_6\text{BM}^S + \epsilon. \qquad (7)\end{aligned}$$

The dependent variable of abnormal short selling now focuses on the time period (-T,-t) with (-2,-1) and (-5,-1) time frames, and so do the control characteristics, while the key independent variable $Ret^C(0,2)$ remains in the (0,2) time period around the announcement date. Results shown in Table X indicate no statistically significant coefficient of $Ret^C(0,2)$ across all model specifications, which imply that short sellers do not trade disproportionately in supplier stock prior to customer news announcements. Such results suggest that short sellers do not anticipate customer news, but that they are highly skillful at processing the flow of information from customer firms to supplier firms. While the goal of this study is not to rule out the use of private information by short sellers, the current evidence suggests that short sellers rely on public information of customer firms for profitable trading opportunities of supplier stock.

IV. Conclusion

We examine whether short sellers are skilled at processing public information pertinent to related firms. We employ customer-supplier links as the setting to pursue this inquiry. Our study is the first to provide evidence that short sellers take advantage of customer news to undertake profitable supplier trades. We show that abnormal supplier short selling is negatively related to post-news customer returns, especially more pronounced in supplier information asymmetry. The established baseline relationship is robust to various sub-samples, alternative abnormal short selling measures, and numerous filters intended to mitigate the possibility that the link is affected by confounding events, especially by the supplier rather than the customer news. Further sensitivity analyses suggest no significant relationship between customer announcement returns and supplier short selling during the time periods when customer-supplier pairs change from linked to delinked status, while the relationship persists when they change from delinked to linked status. We find no significant relationship when we assign customers and suppliers to pseudo relationships. Such findings provide

further support to our main hypothesis that the relation between post-news customer returns and supplier short selling is distinct rather than reflects other effects.

We also establish that supplier short selling in response to customer news generates negative future supplier stock returns, implying that short sellers exhibit superior information processing ability pertinent to related firms. Our findings suggest evidence that information transfers in customer-supplier relationships propagate across the supply chain as we document the increased short selling of supplier's closest rival upon negative customer news announcement returns. Finally, the results suggest no link between supplier short selling *prior* to customer news.

Combined, the evidence indicates that short sellers have superior information processing skills and are able to take advantage of news events pertinent to related firms to capture profitable trading opportunities. Overall, our findings indicate an information intermediary role of short sellers in customer-supplier relationships, and more broadly, along the supply chain. Such results present a channel through which short sellers undertake an important function in financial markets to improve price efficiency.

Figure 2
A Snapshot of the Factset Revere Information on Google in Year 2007

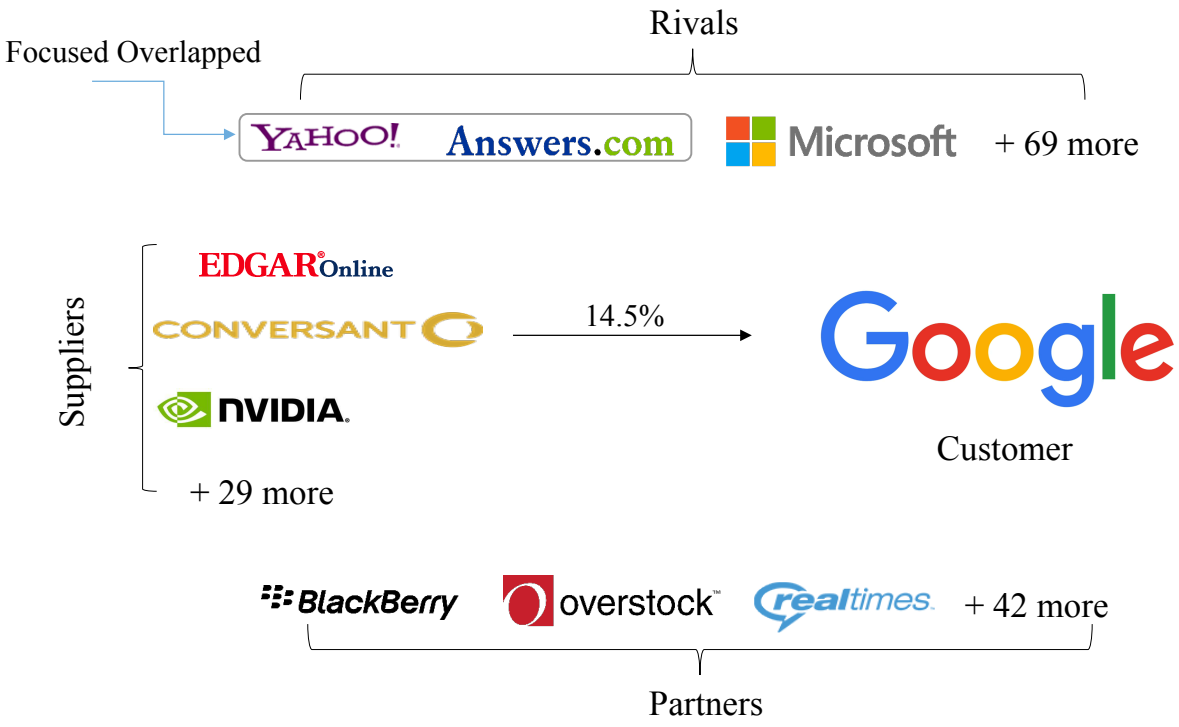

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Table I

Summary Statistics

This table reports the annual number of observations (NObs) for supplier firms, customer firms, and customer-supplier pairs, the average number of suppliers per customer, the average number of customers per supplier, and the average number of Ravenpack customer non-earnings news articles per customer. It also reports the mean, median, and standard deviation of our key variables and various control variables. Our short-sale variables are the supplier absolute short selling ($\text{AbSS}^S(0,T)$), where it is measured over the period from the customer non-earnings news release date, or earnings announcement date at t=0 to T (where T=2 or 5 days after the announcement). Control variables include supplier abnormal volume ($\text{AbVol}^S(0,T)$) during t=0,T relative to traded shares during the non-announcement period, supplier and market returns around customer-news announcement dates ($\text{Ret}^S(0,T)$ and $\text{Ret}^M(0,T)$, respectively), supplier firm size (Size^S), and supplier book-market equity ratio (BM^S). Construction of the variables is defined in Appendix A. Sample period is from July 2005 to July 2007.

	Customer Non-Earnings News				**Customer Earnings News**			
Variable	NObs	Mean	Median	Std Dev	NObs	Mean	Median	Std Dev
Panel A: Supplier/Customer Firms and Customer News								
Number of suppliers per customer		5.566	2	10.589		6.753	2	15.491
Number of customers per supplier		4.776	3	5.502		7.303	4	10.514
Number of news articles per		5.649	6	2.897		7.594	5	6.967
Supplier firms	2,402				2,680			
Customer firms	2,061				2,898			
Customer-supplier pairs	11,477				19,576			
customer-supplier pair								
Customer-supplier pair	52,451				89,328			
year observations								
Panel B: Market Rection to Customer News and Abnormal Short Selling								
$\text{Ret}^C(0,2)$		0.172%	0.111%	2.852%		0.237%	0.183%	5.987%
AbSS(0,2)		-2.245%	-19.38%	67.47%		8.425%	-11.27%	74.16%
AbSS(0,5)		1.658%	-13.82%	64.07%		9.563%	-6.436%	66.10%
Panel C: Control Variables								
$\text{AbVol}^S(0,2)$		-3.502%	-17.78%	62.62%		8.947%	-9.379%	73.28%
$\text{Ret}^S(0,2)$		0.153%	0.062%	3.746%		0.272%	0.176%	4.168%
$\text{Ret}^M(0,2)$		0.108%	0.174%	0.903%		0.167%	0.284%	0.879%
$\text{AbVol}^S(0,5)$		-0.084%	-13.99%	60.35%		9.553%	-5.962%	64.95%
$\text{Ret}^S(0,5)$		0.403%	0.306%	5.485%		0.536%	0.436%	5.807%
$\text{Ret}^M(0,5)$		0.326%	0.449%	1.451%		0.416%	0.536%	1.348%
Size^S		6.128	6.037	2.013		6.727	6.507	2.208
BM^S		48.23%	41.77%	30.71%		45.77%	38.53%	29.69%

Table II

Pearson Correlation Matrix

This table reports the cross-correlation coefficients between the independent variables employed in our baseline analysis with p-values reported in parentheses. Our key variable is post-news customer return ($\text{Ret}^C(0,2)$) measured from the release of customer news at t=0 to day 2. Control variables include the supplier absolute short selling ($\text{AbSS}^S(0,T)$), supplier abnormal volume ($\text{AbVol}^S(0,T)$), supplier and market returns around customer-news announcement dates ($\text{Ret}^S(0,T)$ and $\text{Ret}^M(0,T)$, respectively), supplier firm size (Size^S), and supplier book-market equity ratio (BM^S). Definition and construction of the variables are shown in Appendix A.

	AbSS(0,5)	$\text{Ret}^C(0,2)$	$\text{AbVol}^S(0,2)$	$\text{Ret}^S(0,2)$	$\text{Ret}^M(0,2)$	$\text{AbVol}^S(0,5)$	$\text{Ret}^S(0,5)$	$\text{Ret}^M(0,5)$	Size^S	BM^S
AbSS(0,2)	0.821	-0.011	0.737	0.165	-0.022	0.608	0.123	-0.023	0.030	-0.001
	(<.001)	(0.001)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(0.716)
AbSS(0,5)		-0.009	0.633	0.139	-0.021	0.765	0.168	-0.026	0.019	-0.005
		(0.007)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(0.161)
$\text{Ret}^C(0,2)$			-0.006	0.203	0.371	-0.006	0.138	0.231	-0.002	0.003
			(0.055)	(<.001)	(<.001)	(0.056)	(<.001)	(<.001)	(0.646)	(0.425)
$\text{AbVol}^S(0,2)$				0.106	-0.010	0.810	0.089	-0.018	0.027	0.003
				(<.001)	(0.005)	(<.001)	(<.001)	(<.001)	(<.001)	(0.344)
$\text{Ret}^S(0,2)$					0.324	0.084	0.664	0.206	0.007	-0.012
					(<.001)	(<.001)	(<.001)	(<.001)	(0.046)	(<.001)
$\text{Ret}^M(0,2)$						-0.006	0.219	0.642	0.001	0.007
						(0.058)	(<.001)	(<.001)	(0.68)	(0.040)
$\text{AbVol}^S(0,5)$							0.107	-0.014	0.015	0.000
							(<.001)	(<.001)	(<.001)	(0.896)
$\text{Ret}^S(0,5)$								0.334	0.009	-0.011
								(<.001)	(0.007)	(0.002)
$\text{Ret}^M(0,5)$									0.000	0.003
									(0.927)	(0.356)
Size^S										0.105
										(<.001)

Table III

Supplier Abnormal Short Sales and Post-News Customer Returns

This table reports results from the regression of supplier abnormal short selling on the post-news customer announcement return ($\text{Ret}^C(0,2)$), where the return is measured over the period from the customer non-earnings news release date, or earnings announcement date at t=0 to day 2.

$$\text{AbSS}^S(0,T) \quad = \quad a_0 + a_1\text{Ret}^C(0,2) + a_2\text{AbVol}^S(0,T) + a_3\text{Ret}^S(0,T) + a_4\text{Ret}^M(0,T) + a_5\text{Size}^S + a_6\text{BM}^S + \epsilon.$$

The dependent variable is either the supplier abnormal short selling ($\text{AbSS}^S(0,T)$) or supplier relative short selling ($\text{ReSS}^S(0,T)$). Control variables include supplier abnormal volume ($\text{AbVol}^S(0,T)$) or shorted shares during t=0,T relative to traded shares during the non-announcement period ($\text{NReSS}^S(0,T)$), supplier and market returns around customer-news announcement dates ($\text{Ret}^S(0,T)$ and $\text{Ret}^M(0,T)$, respectively), supplier firm size (Size^S), and supplier book-market equity ratio (BM^S). All the variables are defined in Appendix A. NObs is the number of customer-supplier pairs, and $\bar{R}^2$ is the adjusted R-squared value. All regressions also include supplier firm-year fixed effects (FE), industry-year FE, and all $t-$statistics reported in parentheses are computed based on adjusted standard errors clustered at the supplier firm level. *, **, *** are significance levels denoted at the 10%, 5% and 1%, levels, respectively.

Panel A: Abnormal Short Sales, $\text{AbSS}^S(t,T)$

	Customer Non-Earnings News						**Customer Earnings News**					
	$\text{AbSS}^S(0,2)$			$\text{AbSS}^S(0,5)$			$\text{AbSS}^S(0,2)$			$\text{AbSS}^S(0,5)$		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\text{Ret}^C(0,2)$		-0.652***	-0.677***		-0.293***	-0.285***		-0.113***	-0.119***		-0.075**	-0.081***
		(-2.983)	(-3.030)		(-2.905)	(-2.753)		(-3.176)	(-3.357)		(-2.359)	(-2.609)
$\text{AbVol}^S(0,2)$	1.378***	1.390***	1.392***				1.060***	1.060***	1.060***			
	(5.236)	(5.293)	(5.291)				(14.361)	(14.363)	(14.193)			
$\text{Ret}^S(0,2)$	2.633***	2.589***	2.601***				3.094***	3.104***	3.121***			
	(4.994)	(4.749)	(4.763)				(6.664)	(6.671)	(6.298)			
$\text{Ret}^M(0,2)$	-2.018**	-3.472***	-3.499***				-3.929***	-3.830***	-3.812***			
	(-2.196)	(-3.611)	(-3.709)				(-6.403)	(-6.342)	(-5.814)			
$\text{AbVol}^S(0,5)$				0.388***	0.392***	0.387***				1.207***	1.207***	1.212***
				(4.036)	(3.996)	(3.953)				(9.139)	(9.139)	(9.062)
$\text{Ret}^S(0,5)$				1.989***	2.004***	2.030***				1.441***	1.444***	1.400***
				(8.205)	(7.950)	(8.012)				(5.780)	(5.791)	(5.352)
$\text{Ret}^M(0,5)$				-1.186***	-3.269***	-3.285***				-1.523***	-1.505***	-1.442***
				(-2.704)	(-7.785)	(-8.028)				(-4.818)	(-4.767)	(-4.353)
Size^S	0.002	0.006	-0.012***	-0.022	-0.013	-0.010***	0.019	0.018	-0.008***	0.037	0.037	-0.005***
	(0.070)	(0.166)	(-2.979)	(-0.807)	(-0.504)	(-3.993)	(0.669)	(0.662)	(-4.187)	(1.153)	(1.150)	(-2.679)
BM^S	0.013	-0.016	-0.020	-0.014	-0.025	0.022*	0.027	0.027	0.004	0.047	0.047	-0.007
	(0.203)	(-0.247)	(-0.751)	(-0.327)	(-0.548)	(1.782)	(0.573)	(0.574)	(0.233)	(0.997)	(0.998)	(-0.375)
NObs	52,451	52,451	52,451	52,451	52,451	51,932	89,328	89,328	89,328	89,328	89,328	89,328
$\bar{R}^2$	0.724	0.731	0.719	0.369	0.379	0.333	0.687	0.687	0.668	0.790	0.790	0.774
Firm-Year FE	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Industry-Year FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Table III – Continued

Supplier Abnormal Short Sales and Post-News Customer Returns

	Panel B: Relative Short Sales, $\mathbf{ReSS}^S(t,T)$											
	Customer Non-Earnings News						**Customer Earnings News**					
	$\text{ReSS}^S(0,2)$			$\text{ReSS}^S(0,5)$			$\text{ReSS}^S(0,2)$			$\text{ReSS}^S(0,5)$		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\text{Ret}^C(0,2)$		-0.040***	-0.047***		-0.037***	-0.039***		-0.016***	-0.017***		-0.009**	-0.010**
		(-2.622)	(-3.031)		(-2.948)	(-2.960)		(-3.414)	(-3.465)		(-2.300)	(-2.295)
$\text{ReVol}^S(0,2)$	0.355***	0.346***	0.783***				0.368***	0.368***	0.800***			
	(19.982)	(20.414)	(76.908)				(23.099)	(23.090)	(82.678)			
$\text{Ret}^S(0,2)$	0.360***	0.355***	0.369***				0.381***	0.382***	0.387***			
	(22.425)	(22.414)	(23.336)				(23.702)	(23.780)	(23.807)			
$\text{Ret}^M(0,2)$	-0.063	-0.529***	-0.601***				-0.446***	-0.432***	-0.476***			
	(-1.047)	(-8.772)	(-9.790)				(-8.653)	(-8.335)	(-9.027)			
$\text{ReVol}^S(0,5)$				0.333***	0.327***	0.779***				0.346***	0.346***	0.787***
				(19.438)	(20.231)	(79.719)				(21.946)	(21.940)	(83.456)
$\text{Ret}^S(0,5)$				0.231***	0.230***	0.242***				0.219***	0.220***	0.226***
				(21.724)	(22.829)	(24.026)				(21.634)	(21.663)	(22.060)
$\text{Ret}^M(0,5)$				0.243***	-0.271***	-0.358***				-0.168***	-0.165***	-0.199***
				(6.426)	(-8.282)	(-10.373)				(-5.079)	(-5.008)	(-5.804)
Size^S	0.008*	0.012**	-0.001	0.015***	0.019***	0.000	0.015***	0.015***	-0.001	0.018***	0.018***	-0.000
	(1.655)	(2.409)	(-1.227)	(3.392)	(4.267)	(0.438)	(3.485)	(3.479)	(-1.363)	(4.038)	(4.039)	(-0.235)
BM^S	0.000	-0.002	-0.002	-0.007	-0.009	-0.004**	0.003	0.003	-0.000	-0.001	-0.001	-0.002
	(0.029)	(-0.328)	(-0.961)	(-1.010)	(-1.547)	(-2.072)	(0.417)	(0.418)	(-0.193)	(-0.130)	(-0.131)	(-1.225)
Nobs	52,450	52,450	52,450	52,450	52,450	51,932	89,338	89,325	87,961	89,341	89,328	87,964
$\bar{R}^2$	0.373	0.394	0.323	0.438	0.463	0.385	0.435	0.435	0.367	0.499	0.499	0.423
Firm-Year FE	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Industry-Year FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Table IV
Supplier Information Asymmetry, Supplier Abnormal Short Sales, and Post-News Customer Returns

This table reports results from the regression of supplier abnormal short selling on the post-news customer announcement return ($\text{Ret}^C(0,2)$), where the return is measured over the period from the customer non-earnings news release date or earnings announcement date at t=0 to day 2, and a measure of supplier information asymmetry (InfoAsym).

$$\begin{aligned}\text{AbSS}^S(0,T) &= a_0 + a_1\text{Ret}^C(0,2) + a_2\text{InfoAsym} \times \text{Ret}^C(0,2) + a_3\text{InfoAsym} + a_4\text{AbVol}^S(0,T) + a_5\text{Ret}^S(0,T) + a_6\text{Ret}^M(0,T) \\ &\quad + a_7\text{Size}^S + a_8\text{BM}^S + \epsilon.\end{aligned}$$

The dependent variable is the supplier abnormal short selling ($\text{AbSS}^S(0,T)$). The regression employs three different measures of the supplier information asymmetry binary indicators (InfoAsym), namely top quartile-ranked number of news articles (News), top quartile-ranked institutional ownership (InstOwn), and top-quartile ranked number of analysts following (Analysts). InfoAsym equals 1 if the supplier firm is ranked among the 25% of firms with the lowest level of information asymmetry and 0 if otherwise. Unreported coefficients of the control variables include those of supplier abnormal volume ($\text{AbVol}^S(0,T)$), supplier and market returns around customer earnings announcement dates ($\text{Ret}^S(0,T)$ and $\text{Ret}^M(0,T)$, respectively), supplier firm size (Size^S), and supplier book-market equity ratio (BM^S). All the variables are defined in Appendix A. NObs is the number of customer-supplier pairs, and $\bar{R}^2$ is the adjusted R-squared value. All regressions also include supplier firm-year fixed effects (FE), and all $t-$statistics reported in parentheses are computed based on adjusted standard errors clustered at the supplier firm level. *, **, *** are significance levels denoted at the 10%, 5% and 1%, levels, respectively.

	Customer Non-Earnings News						**Customer Earnings News**					
	$\text{AbSS}^S(0,T)$		$\text{AbSS}^S(0,T)$		$\text{AbSS}^S(0,T)$		$\text{AbSS}^S(0,T)$		$\text{AbSS}^S(0,T)$		$\text{AbSS}^S(0,T)$	
	(0,2)	(0,5)	(0,2)	(0,5)	(0,2)	(0,5)	(0,2)	(0,5)	(0,2)	(0,5)	(0,2)	(0,5)
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
News×	0.193***	0.137***					0.668*	-0.059				
$\text{Ret}^C(0,2)$	(3.546)	(2.599)					(1.688)	(-0.342)				
News	0.026	0.023					0.015	0.007				
	(1.037)	(1.218)					(0.702)	(0.340)				
InstOwn×			0.717*	-0.079					0.230***	0.138***		
$\text{Ret}^C(0,2)$			(1.687)	(-0.447)					(3.963)	(2.651)		
InstOwn			-0.009	0.027					0.024	0.027		
			(-0.418)	(1.478)					(0.568)	(0.607)		
Analysts×					0.490	-0.031					0.166***	0.152***
$\text{Ret}^C(0,2)$					(1.460)	(-0.181)					(3.080)	(2.941)
Analysts					0.000	-0.011					0.018*	0.019*
					(-0.017)	(-0.902)					(1.958)	(1.711)
$\text{Ret}^C(0,2)$	-0.179***	-0.122***	-0.831**	-0.263*	-0.779***	-0.286**	-0.845***	-0.277**	-0.208***	-0.120***	-0.154***	-0.113***
	(-3.606)	(-2.656)	(-2.423)	(-1.846)	(-2.679)	(-2.289)	(-2.672)	(-2.198)	(-3.894)	(-2.688)	(-3.482)	(-2.748)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NObs	89,328	89,328	47053	47053	52451	52451	52,451	52,451	82,096	82,096	89,328	89,328
$\bar{R}^2$	0.687	0.790	0.75	0.382	0.731	0.379	0.731	0.379	0.715	0.811	0.687	0.790
Firm-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table V

Supplier Future Stock Returns and Short Sales

This table tests return predictability of supplier short sales associated with post-news customer announcement return. The dependent variable is supplier future stock returns ($\text{Ret}^S(+t)$) measured over varying horizons from 10, 15, 20, and 40 days following the post-news customer announcement date.

$$\begin{aligned}\text{Ret}^S(+t) &= a_0 + a_1\text{AbSS}^S(0,2) + a_2\text{Ret}^M(+t) + a_3\text{Size}^S + a_4\text{BM}^S + a_5\text{Volatility}^S \\ &\quad + a_6\text{Turnover}^S(+t) + \epsilon.\end{aligned}$$

$\text{AbSS}^S(0,2)$ is the supplier abnormal short selling from the post-news customer announcement date at t=0 to t=2. Control variables include market returns computed over varying horizons that correspond to the supplier future return horizons ($\text{Ret}^M(+t)$), supplier firm size (Size^S), supplier book-market equity ratio (BM^S), supplier return volatility (Volatility^S), and supplier stock turnover (Turnover^S). All the variables are defined in Appendix A. NObs is the number of customer-supplier pairs, and $\bar{R}^2$ is the adjusted R-squared value. All regressions also include supplier firm-year fixed effects (FE), and all $t-$statistics reported in parentheses are computed based on adjusted standard errors clustered at the supplier firm level. *, **, *** are significance levels denoted at the 10%, 5% and 1%, levels, respectively.

	Customer Non-Earnings News			**Customer Earnings News**		
	$\text{Ret}^S(+10)$	$\text{Ret}^S(+15)$	$\text{Ret}^S(+20)$	$\text{Ret}^S(+10)$	$\text{Ret}^S(+15)$	$\text{Ret}^S(+20)$
Variables	(1)	(2)	(3)	(4)	(5)	(6)
AbSS(0 2) (in %)	-0.003	-0.019***	-0.026**	-0.027**	-0.057**	-0.102**
	(-0.835)	(-13.524)	(-6.121)	(-2.149)	(-3.525)	(-3.567)
$\text{Ret}^M(+10)$	1.191***			1.217***		
	(14.959)			(16.894)		
$\text{Ret}^M(+15)$		1.224***			1.250***	
		(13.075)			(15.307)	
$\text{Ret}^M(+20)$			1.265***			1.283***
			(10.896)			(11.356)
$\text{Ret}^M(+40)$						
Size^S	-0.031**	-0.060**	-0.090**	-0.034*	-0.062*	-0.089*
	(-7.259)	(-7.118)	(-7.174)	(-4.031)	(-4.106)	(-3.900)
BM^S	-0.011	-0.021*	-0.031	-0.010	-0.018	-0.026*
	(-2.779)	(-2.926)	(-2.661)	(-1.915)	(-2.573)	(-3.275)
Volatility^S	0.047	0.046	0.064	0.073	0.079	0.105
	(1.370)	(1.206)	(1.538)	(0.763)	(0.726)	(1.375)
Turnover^S	-0.005	-0.016	-0.022	-0.015*	-0.023**	-0.033**
	(-0.984)	(-2.174)	(-2.332)	(-3.262)	(-4.589)	(-5.896)
NObs	78,884	78,884	78,881	89,698	89,697	89,697
$\bar{R}^2$	0.138	0.152	0.177	0.159	0.189	0.226
Firm Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table VI

Linked vs. Delinked Customer-Supplier Relations, Supplier Abnormal Short Sales, and Post-News Customer Returns

This table reports results from the regression of supplier abnormal short selling on the linked vs delinked post-news customer return ($\text{Ret}^C(0,2)$), where the return is measured over the period from the customer non-earnings news release date or earnings announcement date at t=0 to day 2. Specifically, the analysis focuses on a sample of supplier-customer pairs, where the customers are once linked and then become delinked, or are not linked but then become linked with their respective suppliers during the sample period from January 3, 2005 to July 6, 2007.

$$\begin{aligned}\text{AbSS}^S(0,T) &= a_0 + a_1\text{Linked Ret}^C(0,2) + a_2\text{Delinked Ret}^C(0,2) + a_3\text{AbVol}^S(0,T) \\ &\quad + a_4\text{Ret}^S(0,T) + a_5\text{Ret}^M(0,T) + a_6\text{Size}^S + a_7\text{BM}^S + \epsilon.\end{aligned}$$

The dependent variable is the supplier abnormal short selling ($\text{AbSS}^S(0,T)$). Linked $\text{Ret}^C(0,2)$ is a variable that equals the customer return over the announcement date at t=0 to day 2 if the customer is linked to the supplier, and 0 if otherwise. Delinked $\text{Ret}^C(0,2)$ is a variable that equals the customer return over the announcement date at t=0 to day 2 if the customer is delinked from the supplier, and 0 if they become linked. Control variables include supplier abnormal volume ($\text{AbVol}^S(0,T)$) during post-news customer announcements, supplier and market returns during post-news customer announcement dates ($\text{Ret}^S(0,T)$ and $\text{Ret}^M(0,T)$, respectively), supplier firm size (Size^S), and supplier book-market equity ratio (BM^S). All the variables are defined in Appendix A. NObs is the number of customer-supplier pairs, and $\bar{R}^2$ is the adjusted R-squared value. All regressions also include firm-year fixed effects (FE), and all $t-$statistics reported in parentheses are computed based on adjusted standard errors clustered at the supplier firm level. *, **, *** are significance levels denoted at the 10%, 5% and 1%, levels, respectively.

	Customer Non-Earnings News		**Customer Earnings News**	
	AbSS(0,2)	AbSS(0,5)	AbSS(0,2)	AbSS(0,5)
Variables	(1)	(2)	(3)	(4)
Linked $\text{Ret}^C(0,2)$	-0.553**	0.245	-0.170***	-0.083*
	(-2.393)	(0.764)	(-3.085)	(-1.679)
Delinked $\text{Ret}^C(0,2)$	-0.456	-0.061	0.041	0.015
	(-1.303)	(-0.243)	(0.121)	(0.081)
$\text{AbVol}^S(0,2)$	1.506***		1.325***	
	(9.867)		(10.648)	
$\text{Ret}^S(0,2)$	2.231*		2.450***	
	(1.872)		(3.927)	
$\text{Ret}^M(0,2)$	-2.651		-2.908***	
	(-1.455)		(-3.833)	
$\text{AbVol}^S(0,5)$		1.438***		1.433***
		(10.699)		(9.648)
$\text{Ret}^S(0,5)$		1.329***		0.821**
		(3.000)		(2.286)
$\text{Ret}^M(0,5)$		-1.849***		-0.764
		(-2.949)		(-1.560)
Size^S	0.043	0.026	-0.020	0.009
	(1.200)	(0.912)	(-0.408)	(0.189)
BM^S	0.020	0.033	0.018	0.019
	(0.426)	(0.822)	(0.497)	(0.407)
NObs	38,734	38,734	82,140	82,140
$\bar{R}^2$	0.870	0.856	0.813	0.860
Firm-Year	Yes	Yes	Yes	Yes

Table VII

Placebo Tests: Supplier Abnormal Short Sales and Post-News Customer Returns

This table reports results from the regression of supplier abnormal short selling on the post-news customer return ($\text{Ret}^C(0,2)$), where the return is measured over the period from the customer non-earnings news release date or earnings announcement date at t=0 to day 2.

$$\begin{aligned}
\text{Pseudo Supplier:}\quad \text{AbSS}^{S*}(0,T) &= a_0 + a_1\text{Ret}^C(0,2) + a_2\text{AbVol}^{S*}(0,T) + a_3\text{Ret}^{S*}(0,T) + a_4\text{Ret}^M(0,T) \\
&\quad + a_5\text{Size}^{S*} + a_6\text{BM}^{S*} + \epsilon. \\
\text{Pseudo Customer:}\quad \text{AbSS}^{S}(0,T) &= a_0 + a_1\text{Ret}^{C*}(0,2) + a_2\text{AbVol}^{S}(0,T) + a_3\text{Ret}^{S}(0,T) + a_4\text{Ret}^M(0,T) \\
&\quad + a_5\text{Size}^{S} + a_6\text{BM}^{S} + \epsilon.
\end{aligned}$$

The dependent variable is the supplier abnormal short selling ($\text{AbSS}^S(0,T)$). $S*$ denotes a supplier matched to the linked supplier by industry and closest size and BM; $C*$ denotes a customer matched to the linked customer by industry and by closest size and BM. Control variables include supplier abnormal volume ($\text{AbVol}^S(0,T)$), supplier and market returns around post-news customer dates ($\text{Ret}^S(0,T)$ and $\text{Ret}^M(0,T)$, respectively), supplier firm size (Size^S), and supplier book-market equity ratio (BM^S). All the variables are defined in Appendix A. NObs is the number of customer-supplier pairs, and $\bar{R}^2$ is the adjusted R-squared value. All regressions also include supplier firm-year fixed effects (FE), and all $t-$statistics reported in parentheses are computed based on adjusted standard errors clustered at the pseudo supplier firm level or pseudo customer firm level. *, **, *** are significance levels denoted at the 10%, 5% and 1%, levels, respectively.

	Customer Non-Earnings News				**Customer Earnings News**			
	Pseudo Suppliers		**Pseudo Customers**		**Pseudo Suppliers**		**Pseudo Customers**	
	$\text{AbSS}^{S*}(0,2)$	$\text{AbSS}^{S*}(0,5)$	$\text{AbSS}^{C*}(0,2)$	$\text{AbSS}^{C*}(0,5)$	$\text{AbSS}^{S*}(0,2)$	$\text{AbSS}^{S*}(0,5)$	$\text{AbSS}^{C*}(0,2)$	$\text{AbSS}^{C*}(0,5)$
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{Ret}^C(0,2)$	-0.057	-0.013			-0.003	-0.012		
	(-0.120)	(-0.049)			(-0.089)	(-0.377)		
$\text{Ret}^{C*}(0,2)$			0.167	0.060			-0.038	-0.036
			(0.946)	(0.648)			(-0.849)	(-0.961)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NObs	38,593	38,593	48,238	48,238	83,889	83,889	59,986	59,986
$\bar{R}^2$	0.653	0.693	0.805	0.540	0.815	0.800	0.878	0.877
Firm-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table VIII

Supplier Rival's Abnormal Short Sales and Post-News Customer Returns

This table reports results from the regression of supplier's rival abnormal short selling on the post-news customer announcement return ($\text{Ret}^C(0,2)$), where the return is measured over the period from the customer non-earnings news release date or earnings announcement date at t=0 to day 2.

$$\text{AbSS}^R(0,T) = a_0 + a_1\text{Ret}^C(0,2) + a_2\text{Ret}^S(0,T) + a_3\text{AbVol}^R(0,T) + a_4\text{Ret}^R(0,T) + a_5\text{Ret}^M(0,T) + a_6\text{Size}^R + a_7\text{BM}^R + \epsilon.$$

The dependent variable is the supplier's closest or distant rival's abnormal short selling ($\text{AbSS}^R(0,T)$). Control variables include supplier return ($\text{Ret}^S(0,2)$), rival abnormal volume ($\text{AbVol}^R(0,T)$), supplier's rival and market returns around customer-news announcement dates ($\text{Ret}^R(0,T)$ and $\text{Ret}^M(0,T)$, respectively), supplier's rival firm size (Size^R) and book-market equity ratio (BM^R). All the variables are defined in Appendix A. NObs is the number of customer-supplier pairs, and $\bar{R}^2$ is the adjusted R-squared value. All regressions also include supplier's rival firm-year fixed effects (FE), and all $t-$statistics reported in parentheses are computed based on adjusted standard errors clustered at the supplier's rival firm level. *, **, *** are significance levels denoted at the 10%, 5% and 1%, levels, respectively.

	Customer Non-Earnings News								**Customer Earnings News**							
	Closest Rival				Distant Rival				Closest Rival				Distant Rival			
	$\text{AbSS}^S(0,2)$		$\text{AbSS}^S(0,5)$		$\text{AbSS}^S(0,2)$		$\text{AbSS}^S(0,5)$		$\text{AbSS}^S(0,2)$		$\text{AbSS}^S(0,5)$		$\text{AbSS}^S(0,2)$		$\text{AbSS}^S(0,5)$	
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
$\text{Ret}^C(0,2)$	-0.176**	-0.145*	-0.099	-0.061	-0.281	-0.258	-0.105	-0.050	-0.067*	-0.067*	-0.077***	-0.070**	-0.057	-0.049	-0.086	-0.077
	(-2.068)	(-1.702)	(-1.325)	(-0.782)	(-1.607)	(-1.481)	(-0.624)	(-0.280)	(-1.700)	(-1.727)	(-2.618)	(-2.425)	(-0.768)	(-0.670)	(-1.529)	(-1.366)
$\text{Ret}^R(0,2)$	2.045***	2.087***			3.701***	3.712***			1.066***	1.065***			3.295***	3.311***		
	(10.837)	(10.869)			(5.203)	(5.211)			(5.370)	(5.323)			(4.163)	(4.169)		
$\text{Ret}^S(0,2)$		-0.301***				-0.228				0.008				-0.288**		
		(-3.012)				(-1.532)				(0.099)				(-2.086)		
$\text{Ret}^R(0,5)$			1.253***	1.266***			1.413	1.418			0.665***	0.671***			1.839***	1.845***
			(9.048)	(9.075)			(1.477)	(1.485)			(4.135)	(4.160)			(5.483)	(5.497)
$\text{Ret}^S(0,5)$				-0.199***				-0.294**				-0.141**				-0.217**
				(-2.628)				(-2.206)				(-2.181)				(-2.329)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NObs	45,889	45,886	45,905	45,902	20,473	20,473	20,473	20,473	84,151	84,149	84,151	84,149	41,894	41,894	41,942	41,942
$\bar{R}^2$	0.542	0.542	0.566	0.566	0.608	0.608	0.571	0.571	0.584	0.584	0.552	0.552	0.614	0.614	0.689	0.690
Firm-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IX

Upstream Supplier Abnormal Short Sales and Post-News Customer Returns

This table reports results from the regression of upstream supplier abnormal short selling on the post-news customer announcement return ($\text{Ret}^C(0,T)$), where the return is measured over the period from the customer non-earnings news release date or earnings announcement date at t=0 to day 2.

$$\begin{aligned}\text{AbSS}^{SS}(0,T) &= a_0 + a_1\text{Ret}^C(0,2) + a_2\text{AbVol}^{SS}(0,T) + a_3\text{Ret}^{SS}(0,T) + a_4\text{Ret}^M(0,T) + a_5\text{Size}^{SS} \\ &\quad + a_6\text{BM}^{SS} + \epsilon.\end{aligned}$$

The dependent variable is the upstream supplier abnormal short selling ($\text{AbSS}^{SS}(0,T)$). Control variables include those of upstream supplier abnormal volume ($\text{AbVol}^{SS}(0,T)$), upstream supplier and market returns around customer news announcement dates ($\text{Ret}^{SS}(0,T)$ and $\text{Ret}^M(0,T)$, respectively), upstream supplier firm size (Size^{SS}), and supplier book-market equity ratio (BM^{SS}). All the variables are defined in Appendix A. NObs is the number of customer-supplier-supplier links, and $\bar{R}^2$ is the adjusted R-squared value. All regressions also include upstream supplier firm-year fixed effects (FE), and all $t-$statistics reported in parentheses are computed based on adjusted standard errors clustered at the upstream supplier firm level. *, **, *** are significance levels denoted at the 10%, 5% and 1%, levels, respectively.

	Customer Non-Earnings News		**Customer Earnings News**	
	$\text{AbSS}^{SS}(0,2)$	$\text{AbSS}^{SS}(0,5)$	$\text{AbSS}^{SS}(0,2)$	$\text{AbSS}^{SS}(0,5)$
Variables	(1)	(2)	(3)	(4)
$\text{Ret}^C(0,2)$	-0.122	-0.098	0.018	-0.003
	(-1.362)	(-1.274)	(0.474)	(-0.089)
$\text{AbVol}^{SS}(0,2)$	1.019***		0.627***	
	(16.111)		(2.873)	
$\text{Ret}^{SS}(0,2)$	2.080***		2.298***	
	(5.683)		(3.834)	
$\text{Ret}^M(0,2)$	-3.047***		-3.025***	
	(-5.087)		(-3.574)	
$\text{AbVol}^{SS}(0,5)$		1.064***		0.847***
		(17.024)		(6.610)
$\text{Ret}^{SS}(0,5)$		1.362***		1.384***
		(6.479)		(4.876)
$\text{Ret}^M(0,5)$		-1.937***		-1.443***
		(-5.929)		(-2.665)
Size^{SS}	-0.001	-0.007	0.013	0.020
	(-0.041)	(-0.289)	(0.370)	(0.634)
BM^{SS}	0.012	0.006	0.063	0.073
	(0.190)	(0.111)	(0.726)	(0.743)
NObs	51,588	51,678	82,350	82,350
$\bar{R}^2$	0.605	0.640	0.414	0.533
Firm-Year	Yes	Yes	Yes	Yes

Table X

Pre-News Supplier Abnormal Short Sales and Post-News Customer Returns

This table reports results from the regression of supplier abnormal short selling prior to customer-news releases on the post-news customer announcement return ($\text{Ret}^C(0,2)$), where the return is measured over the period from the customer non-earnings news release date or earnings announcement date at t=0 to day 2.

$$\begin{aligned}\text{AbSS}^S(-T,-t) &= a_0 + a_1\text{Ret}^C(0,2) + a_2\text{AbVol}^S(-T,-t) + a_3\text{Ret}^S(-t,-T) + a_4\text{Ret}^M(-T,-t) + a_5\text{Size}^S \\ &\quad + a_6\text{BM}^S + \epsilon.\end{aligned}$$

The dependent variable is the supplier abnormal short selling ($\text{AbSS}^S(-T,-t)$). Control variables include supplier abnormal volume ($\text{AbVol}^S(-T,-t)$), supplier and market returns around customer-news announcement dates ($\text{Ret}^S(-T,-t)$ and $\text{Ret}^M(-T,-t)$, respectively), supplier firm size (Size^S), and supplier book-market equity ratio (BM^S). All the variables are defined in Appendix A. NObs is the number of customer-supplier pairs, and $\bar{R}^2$ is the adjusted R-squared value. All regressions also include supplier firm-year fixed effects (FE), and all $t-$statistics reported in parentheses are computed based on adjusted standard errors clustered at the supplier firm level. *, **, *** are significance levels denoted at the 10%, 5% and 1%, levels, respectively.

	Customer Non-Earnings News		**Customer Earnings News**	
	$\text{AbSS}^S(-2,-1)$	$\text{AbSS}^S(-5,-1)$	$\text{AbSS}^S(-2,-1)$	$\text{AbSS}^S(-5,-1)$
Variables	(1)	(2)	(3)	(4)
$\text{Ret}^C(0,2)$	0.120	0.100	0.008	0.044
	(0.946)	(0.950)	(0.188)	(1.260)
$\text{AbVol}^S(-2,-1)$	0.197		1.002***	
	(1.572)		(7.166)	
$\text{Ret}^S(-2,-1)$	1.129**		2.624***	
	(2.325)		(3.760)	
$\text{Ret}^M(-2,-1)$	-1.848***		-1.140	
	(-3.587)		(-1.491)	
$\text{AbVol}^S(-5,-1)$		0.356***		1.298***
		(3.690)		(7.638)
$\text{Ret}^S(-5,-1)$		1.195***		1.074***
		(2.820)		(3.111)
$\text{Ret}^M(-5,-1)$		-1.809***		-1.251***
		(-3.570)		(-3.328)
Size^S	-0.024	0.009	-0.001	0.024
	(-0.812)	(0.357)	(-0.024)	(0.790)
BM^S	0.025	-0.013	0.018	0.032
	(0.693)	(-0.419)	(0.308)	(0.590)
NObs	52,451	52,451	89,327	89,328
$\bar{R}^2$	0.209	0.340	0.685	0.818
Firm-Year	Yes	Yes	Yes	Yes

Appendix A
Variable Definition and Data Source

Variable	Definition	Data Source
AbSS(0,T)	The difference between the average daily number of a supplier firm's shares sold short from its customer's news release date at day 0 to day T (T=2, 5) and the average daily number of the supplier firm's shares sold short during the non-announcement period; the difference is then normalized by the latter. The non-announcement period is the period within the quarter that the Ravenpack news is released, but excluding the days from day 0 to day T. In the case of earnings announcements, the non-announcement period is measured between day -57 and day -T (T=2, 5) from the announcement date set at day 0.	Manual collection from various stock exchanges' websites, including NYSE TAQ database.
$\text{Ret}^C(0,2)$	Customer firm's cumulative return associated with own non-earnings news release date or earnings announcement date at day 0 to day 2.	CRSP
$\text{AbVol}^S(t,T)$	The difference between the average daily stock turnover of a supplier firm for day t to day T (T=2, 5) and the average daily number of stock turnover during the non-announcement period and then divide the difference by the latter.	CRSP
$\text{Ret}^S(t,T)$	Supplier firm's cumulative return associated with customer news or earnings announcement from day t to day T.	CRSP
$\text{Ret}^M(t,T)$	Market's cumulative return associated with customer news or earnings announcement from day t to day T.	CRSP
$\text{ReSS}^S(0,T)$	The number of shorted shares relative to traded shares of a supplier firm during the period from the customer news release or earnings announcement day 0 to day T.	Manual collection from various stock exchanges' websites, including NYSE TAQ database; CRSP
$\text{NReSS}^S(0,T)$	The number of shorted shares relative to traded shares of a supplier firm during the non-announcement period, which is between day -57 and day -T, (T=2, 5).	Manual collection from various stock exchanges' websites, including NYSE TAQ database; CRSP
Size^S	Log of total assets of supplier firm in year $t-1$.	Compustat
BM^S	Book to market equity ratio of supplier firm in year $t-1$.	Compustat
Linked $\text{Ret}^C(0,2)$	A variable that equals the customer firm's cumulative return associated with own news release or earnings announcement date at day 0 to day 2 if the customer is linked to the supplier, and 0 if otherwise.	CRSP
Delinked $\text{Ret}^C(0,2)$	A variable that equals the customer firm's cumulative return associated with own news release or earnings announcement date at day 0 to day 2 if the customer is delinked from the supplier, and 0 if they become linked.	CRSP

Appendix A – Continued
Variable Definition and Data Source

Variable	Definition	Data Source
News	A binary variable that equals 1 if the supplier firm is ranked among the 25% of supplier firms with most number of news articles.	Ravenpack
InstOwn	A binary variable that equals 1 if the supplier firm is among the top 25% of supplier firms with the largest institutional ownership.	Thomson Reuters
Analysts	A binary variable that equals 1 if the supplier firm is among the top 25% of supplier firms with the largest number of analyst coverage.	IBES
$\text{Ret}^S(+t)$	Cumulative future supplier stock return over the subsequent t days to the window used to compute AbSS(0,T).	CRSP
$\text{Ret}^M(+t)$	Cumulative future market stock return over the subsequent t days to the window used to compute AbSS(0,T).	CRSP
Volatility^S	Daily standard deviation of supplier stock returns computed over the past month.	CRSP
Turnover^S	Average daily number of supplier shares traded over the past month.	CRSP