

Short Interest and Corporate Investments: Evidence from Business Partners

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Comments Welcome

Abstract

Short interest contains valuable information about a firm's business fundamentals. We investigate whether such information affects business partners' real investment decisions in the supply-chain setting. We predict and find that a supplier's future investments (including inventory, R&D, and tangible asset investments) decrease with its customer's current short interest. This negative relation is stronger when the supplier faces greater difficulty in assessing its customer's business fundamentals and when short interest is more likely to indicate long-lasting deterioration in the customer's fundamentals. Additional analysis does not support the alternative explanation that the supplier adjusts investments in response to unfavorable information obtained via private communication with its customer. We also find that suppliers who are more responsive to the customers' short interest in reducing investments experience weaker wealth transfer from these customers and better investment efficiency. Overall, our evidence suggests that customers' short interest has significant information value in facilitating suppliers' investment decisions, and suppliers who adjust their investments based on such information enjoy greater economic benefits.

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1. Introduction

Short sellers are becoming an increasingly important group of market participants, accounting for 24% of NYSE and 31% of Nasdaq trading volume in 2005 (e.g., Diether, Lee, and Werner 2009). Prior research suggests that short sellers have superior ability in processing public information and acquiring private information, facilitating the discovery of overvalued companies and leading to more efficient price formation and greater market liquidity (e.g., Miller 1977; Diamond and Verrecchia 1987; Cohen, Diether, and Malloy 2007; Blocher, Reed, and Wesep 2013). Other than informing capital markets, recent research suggests that short sellers can discipline managerial behavior. For instance, short sellers can facilitate the discovery of corporate misconduct and discourage managers from manipulating earnings (e.g., Desai, Krishnamurthy, and Venkataraman 2006; Karpoff and Lou 2010; Massa, Zhang, and Zhang 2015; Fang, Huang, and Karpoff 2015). Nevertheless, short sellers can engage in speculative or predatory trading, potentially distorting stock prices. Recent theoretical research recognizes such undesirable aspects of short selling, and predicts that predatory short selling can destroy firm value by inducing managers to make inefficient corporate investment decisions (Goldstein and Guembel 2008).¹

In this study, we empirically examine the real effects of short selling on stakeholders' investment decisions in the supply-chain context. Specifically, we examine whether a customer's short interest affects its supplier's investment decisions.² Short sellers are incentivized to acquire

¹ Goldstein and Guembel (2008) suggest that short sellers can manipulate prices downwards to induce managers to make bad decisions and destroy firm value. Relatedly, Khanna and Mathews (2012) argue that short interest can affect the real decisions of the firm's blockholders by forcing inefficient liquidation of blockholders' long-term assets.

² We focus on the influence of a customer's short interest over its supplier's investment decisions, rather than the other way around, because of the asymmetric disclosure requirement of the identities of a firm's suppliers and customers. Based on SFAS No. 14, a firm is required to report the identities of major customers to which the total value of sales exceeds 10% of the reporting firm's total sales, but there is no disclosure requirement of the identities of a firm's major suppliers. As a result, reported major customers are much larger than their suppliers and

a firm's negative news. As supply-chain network generates operational and financial interdependence among parties in the same supply chain, a customer's negative news conveyed through its short interest is likely to be critical to its supplier given that (i) the severity of the hold-up problem increases when the customer's performance deteriorates (e.g., Joskow 1987);³ (ii) the customer's managers have incentives to be less forthcoming about bad news than good news (e.g., Raman and Shahrur 2008; Hui, Klasa, and Yeung 2012; Leung 2012); and (iii) such negative news may not yet be incorporated into alternative public signals (such as the customer's share price or analysts' forecasts) (e.g., Akbas, Boehmer, Erturk, and Sorescu 2008; Boehmer, Jones, and Zhang 2008; Cohen and Frazzini 2008; Francis, Venkatachalam, and Zhang 2008).⁴

Consequently, the adverse information in the customer's short position can facilitate the supplier's timely adjustments of business strategies and improve the supplier's investment decisions. While the information contained in customers' short interest and the information that suppliers use to make investment decisions may overlap to some extent, short interest likely has incremental information value that can inform suppliers' investment decisions, because short sellers often engage in private information acquisitions and they possess superior skills of processing public information (e.g., Engelberg, Reed, and Ringgenberg 2012). Hence, we expect that suppliers respond to their customers' short interest by adjusting investment strategies so as to reduce risk exposure to the (potentially deteriorating) circumstances of customers.

economically more important to their suppliers than the other way around, presumably enhancing the influence of a customer's short interest over its supplier's investment decisions.

³ The hold-up problem arises when a customer can exercise high bargaining power over its supplier following the supplier's investment in relationship-specific assets (which represent sunk investments ex post). This problem worsens with the customer's financial distress. As an example, General Motors issued a significant profit warning in 2005, and subsequently pressed its suppliers for price breaks to reduce its operating costs.

⁴ Other than predicting future price declines, short interest can predict future deterioration of firm fundamentals such as downward analyst forecast revisions and negative earnings surprises (e.g., Akbas, Boehmer, Erturk, and Sorescu 2008; Francis et al. 2008; Boehmer, Jones, and Zhang 2012).

Specifically, we predict that after observing strong short interest in customers' equity, suppliers reduce or slow down inventory production/purchases in anticipation of customers' declining demand, because inventory decisions directly relate to the projection of customers' near-term demand and can be adjusted in a relatively timely manner. We also predict that suppliers will curtail or halt relationship-specific investments, as reflected in both intangible asset investments (R&D expenditure) and tangible asset investments (capital expenditure). Suppliers often need to invest in unique technologies and/or customized equipment to tailor to the specific production process required by their customers.⁵ Such relationship-specific investments represent an informal business commitment between supply-chain partners, because the underlying assets cannot be deployed freely for alternative uses. Slowing-down relationship-specific investments is consistent with the notion that short interest alerts suppliers to customers' declining business, and hence suppliers become less confident about the sustainability of the supply-chain relationship and more worried about the hold-up problem in the face of negative information about the customers.

We test the above predictions using a sample of 16,448 supplier-customer-quarter observations over the period 1988-2011. Consistent with our predictions, we find that following stronger short interest in customers' equity, suppliers more aggressively reduce or slow down inventory production/purchases, R&D expenditures, and capital expenditures. These results hold for both the observed total short interest in customers' equity and the estimated abnormal short interest (unrelated to macro-level sentiment in short selling activities). The results are also robust to taking into account the endogenous nature of customers' short interest and to controlling for a comprehensive list of explanatory variables, including the customer-supplier interdependence,

⁵ For example, Coca-Cola Company requires its suppliers to comply with various specifications regarding ingredients, packaging, laboratory services, storage, transfer and filling stations, etc. The required knowledge, technologies, and productive facilities often cannot be easily redeployed to serve other soft drink makers.

supplier characteristics (such as suppliers' own short interest and performance), and customer characteristics (such as current and future performance and analyst following). Overall, our results support a causal effect of customers' short interest on suppliers' investment activities, suggesting that customers' short interest has significant information value for suppliers' investment decisions.⁶

We conduct cross-sectional analyses to reinforce the main findings. Specifically, we predict a stronger effect of customers' short interest on suppliers' investment decisions when short interest is more likely to have *incremental* information value for the suppliers to understand their customers' *fundamentals*. First, we argue that short interest is more likely to have incremental information value when suppliers face difficulty in evaluating their customers' business fundamentals, in cases where customers have opaque information environment or have more volatile business operations. Second, we argue that short interest is more likely to convey information about customers' fundamentals when customers' short interest is more persistent, since long-lasting short positions likely suggest deterioration in customers' business fundamentals as opposed to temporary price decline in the future. Results from the cross-sectional tests are consistent with these predictions.

We conduct additional analyses to address several concerns. The first concern is that customers' short interest may simply capture the unfavorable information suppliers already

⁶ Our hypotheses specifically relate to the supplier's *near-term* responses to the customer's short interest, under the assumption that in the short run, the supplier cannot easily replace the loss of this customer's business with other businesses (from either existing customers or new customers). In the intermediate and long term, suppliers may expand business with other customers (those not subject to strong short interest), seek additional customers to establish new supply-chain relationship, and/or diversify business operations to be less reliant on a few major customers. Such activities likely require new investments. To the extent that managers are able to undertake such activities in the short run, we are less likely to detect the supplier's direct response to its customer's short interest. Empirically, we find that over a longer horizon such as three years, customers' short interest has a weaker effect on suppliers' inventory and R&D investments, and an insignificant effect on suppliers' capital expenditures (untabulated). Our findings combined are consistent with suppliers responding to customers' short interest by cutting investments in the near term but seeking alternative business opportunities to counter this adverse effect in the intermediate and long term.

obtained through private communication with their customers. This alternative explanation appears inconsistent with prior research suggesting that customers have incentives to convey favorable information, rather than unfavorable information, to their suppliers (e.g., Cachon and Lariviere 2001; Raman and Shahrur 2008; Hui et al. 2012; Leung 2012). Nevertheless, to assess this possibility, we assume that the news content in customers' public disclosures is consistent with what has been communicated privately with suppliers.⁷ We use customers' voluntary disclosure (captured by earnings guidance) and mandatory financial reporting (captured by discretionary accruals) to identify the news content in public disclosures. We find that suppliers more aggressively reduce or slow down corporate investments following customers' short interest when customers' earnings guidance and discretionary accruals contains favorable news. Such evidence runs counter to the alternative explanation, which predicts stronger results when private communication conveys negative news, but supports the argument that suppliers rely more on short positions to assess customers' business fundamentals when customers' public disclosures (as well as private communication) disagree with the adverse information in short interest and have a greater likelihood of being biased.

The second concern relates to measurement noises in short interest and investments. Short sellers may take positions in customer firms for hedging purposes, rather than based on beliefs about customers' declining fundamentals. To reduce this measurement noise, we repeat the analyses after excluding customer firms that are included in the major stock market index (S&P 1500), as index firms are more likely to be shorted as part of hedging strategies. We find quantitatively similar results. Suppliers' investment variables are also measured with noises.

⁷ As private communication is unobservable, we have to rely on this assumption to conduct empirical tests. We believe that this is a reasonable assumption. If customers announce positive news through public disclosures but communicate negative news through private communication with suppliers, or vice versa, customers' disclosures may be deemed unreliable by suppliers and customers may face reputation costs and the risk of losing business partners.

While our arguments apply to investments associated with the customer experiencing strong short interest, our empirical tests rely on firm-level aggregate investments that include investments in relation to other customers (who may have little short interest). We design the following test to indirectly address this concern. Prior studies document a wealth transfer effect along the supply chain (e.g., Cohen and Frazzini 2008; Hertz, Li, Officer, and Rodgers 2008; Pandit, Wasley, and Zach 2011). To the extent that a supplier adjusts investments associated with its customer who attracts strong short interest, we predict a weaker wealth transfer from this particular customer after the supplier makes investment adjustments. The evidence is supportive of this prediction.

We also provide preliminary evidence on the economic benefits of suppliers' investment adjustments in response to customers' short interest. When short interest contains useful information to assess customers' business fundamentals, corresponding investment adjustments can improve suppliers' investment efficiency by reducing risk exposure to deteriorating customers. However, short interest can be a noisy or misleading signal of customers' business fundamentals, confounded by transitory price fluctuations and hedging motivations. It is ex ante unclear how effectively suppliers utilize the information in short interest and whether suppliers' subsequent investment adjustments improve investment efficiency. We find that, for suppliers who have more (less) aggressively curtailed investments in response to customers' short interest, current investments generate greater (less) future cash flows. This finding supports the notion that on average, suppliers' more responsive investment adjustments based on customers' short interest improve suppliers' investment efficiency.

Our study contributes to the literature in several ways. First, we provide new evidence on the real effect of short sellers in affecting business partners' decision making. Prior empirical

studies predominantly examine the role of short sellers in facilitating price discovery in the equity and debt markets (e.g., Cohen et al. 2007; Blocher et al. 2013; Kecskes, Mansi, and Zhang 2013). Recent research starts to explore the implications of short selling beyond the capital market (e.g., Goldstein and Guembel 2008; Khanna and Mathews 2012). Our study extends this line of inquiry by examining the spillover effect of short interest on business partners' (in particular suppliers') investments. The evidence speaks to the importance of short sellers in affecting supply-chain investments and the efficient functioning of product markets.

Our study is broadly related to the literature on the feedback effect from the stock market to corporate investment decisions (e.g., Baker, Stein, and Wurgler 2003; Edmans, Goldstein, and Jiang 2012; Foucault and Fresard 2014). We extend this literature by providing evidence that short interest has a significant impact on stakeholders' investments above and beyond share prices, consistent with short sellers' superior ability to unearth new information. Our focus on the supply-chain setting, a setting where the negative information in short interest is particularly important due to the potential hold-up problem and biased information transfer along the supply chain, distinguishes our paper from Chang, Lin, and Ma (2014) and Grullon, Michenaud, and Weston (2015), who examine the effect of short selling constraints on a firm's own investments and conclude that the threat of short selling reduces corporate overinvestment.

Second, our evidence illustrates the importance of customers' short interest in suppliers' information acquisition and utilization. Information sharing along the supply chain may be incomplete or even biased, which can mislead suppliers' investment decisions (e.g., Lee, So, and Tang 2000; Baiman and Rajan 2002; Raman and Sharur 2008). Our findings suggest that customer's short interest provides a valuable information signal that helps suppliers validate information obtained from customers and alert suppliers to customers' potential problems. The

evidence also demonstrates the economic benefits to the suppliers of utilizing the information in customers' short interest.

Third, prior research documents that economic interdependence and information sharing between business partners lead to cross-firm return predictability (Cohen and Frazzini 2008; Pandit et al. 2011) and wealth transfer along the supply chain (Kulp, Lee, and Ofek 2004; Hertz et al. 2008). More recently, Murfin and Njoroge (2014) document that slower payment by major customers can force their suppliers to cut investments. We complement prior research by examining the impact of customers' short interest on suppliers' investment decisions. Our evidence shows that suppliers, by being responsive to customers' short interest, are able to reduce the extent of wealth transfer from their deteriorating customers.

The rest of the paper is organized as follows. Section 2 discusses related literature and develops testable hypotheses. Section 3 presents the sample, variable measurement, and descriptive statistics. Section 4 provides the results for the main and cross-sectional tests. Section 5 presents the results for the additional analyses, and Section 6 concludes.

2. Hypothesis Development

2.1 Main Hypothesis

Despite widespread complaints of manipulative short selling and regulatory restrictions on short sales, short sellers are generally considered as informed traders and there is plenty of empirical evidence that short selling helps correct the over-valuation of stocks and contributes to information discovery.⁸ Prior studies suggest that short sellers' information advantage comes from private information acquisition and skilled processing of public information (e.g., Desai,

⁸ For examples, see Dechow, Hutton, Meulbroek, and Sloan (2001), Jones and Lamont (2002), Ofek and Richardson (2003), Pownall and Simko (2005), Desai et al. (2006), Boehmer, Jones, and Zhang (2008), Hirshleifer, Toeh, and Yu (2011), Boehmer and Wu (2013), Kecskes et al. (2013), and Drake, Roulstone, and Thornock (2015).

Krishnamurthy, and Venkataraman 2006; Drake, Rees, and Swanson 2011; Engelberg et al. 2012; Christensen, Drake, and Thornock 2013).

In general, short sellers take position in a firm's equity hoping to profit from future price declines when they believe that the firm is over-valued.⁹ There are several ways for short sellers to achieve their goal (Staley 1997). First, short sellers can identify adverse changes in firms' external environment and business prospect, such as increased competition and inflexible operations that may lead to subsequent declining demand or rising costs. Consistently, prior research shows that short sales can predict future deterioration of firm performance, including poor earnings realizations, analyst downgrades, and downward analyst forecast revisions (e.g., Pownall and Simko 2005; Francis et al. 2008; Boehmer et al. 2012). Second, short sellers can detect firms' deliberate misrepresentation and omission of historical financial data that have misled market expectations. Prior studies provide consistent evidence that short sellers anticipate the incidence and severity of financial misconduct (e.g., Desai et al. 2006; Karpoff and Lou 2010). Third, short sellers are proficient at analyzing publicly available information to identify stocks that are over-priced relative to business fundamentals, such as identifying price "bubbles" alleged for Internet stocks in early 2000 (e.g., Dechow et al. 2001; Curtis and Fargher 2014).¹⁰

The adverse news conveyed through short sales should be useful to suppliers' investment decisions. First, short sales can alert suppliers to customers' deteriorating fundamentals (e.g., due to increased competition or operational weaknesses), thus prompting suppliers to make adjustments in operational and strategic plans.¹¹ In particular, if suppliers perceive declining

⁹ Short position can also arise from hedging needs or manipulative intentions. We are not interested in such short positions. Empirically, such positions add noises and reduce the power of the tests.

¹⁰ However, Daske, Richardson, and Tuna (2005) find no evidence consistent with short sellers anticipating negative earnings shocks.

¹¹ Note that the customers' deteriorating fundamentals here are relative to current market expectations. It is entirely possible that financially healthy customers are subject to overvaluation. As long as what is revealed through

demand after observing customers' short interest, they can reduce inventory buffers by cutting or slowing down inventory production or purchases. If suppliers lose confidence in continuing the supply-chain relationship, they may curtail related technological investments and slow down the expansion of, or even shrink, related production capacity, to minimize the potential hold-up problem. Second, customers have incentives to communicate biased and incomplete information to suppliers, hoping to induce suppliers to over-invest (e.g., Cachon and Lariviere 2001; Raman and Sharur 2008). Suppliers' investment decisions may be misled by the biased and incomplete information from customers, especially when customers' stock prices do not fully reveal firm fundamentals. Strong short interest in customers' equity acts as a disciplinary mechanism in customer's reporting system (Massa et al. 2015). It also sends a warning to suppliers to more critically scrutinize customers' financial information and correct previous over-investments. Further, intentional biases in financial information, once discovered, tarnish firm reputation and may trigger management turnover (e.g., Desai, Hogan, and Wilkins 2006), which impedes customers' ordinary course of business. Such anticipation will also prompt suppliers to adjust investment plans.¹²

If the negative information in customers' short interest is immediately incorporated into customers' share prices, customer's short interest may not have incremental information value beyond the observed share prices. However, prior studies show that it takes time for the information in short interest to be incorporated into share prices, possibly due to limits to

customers' short positions is worse than current market expectations (which have affected suppliers' investment decisions), suppliers should adjust investments by slowing down or curtailing investments.

¹² In theory, short selling can have a real feedback effect on customers' business operations, other than revealing negative news about business fundamentals. For instance, short selling can limit a firm's growth opportunities by tarnishing the firm's corporate image. It is possible that suppliers adjust investments in anticipation of the adverse real effect of short selling on customers' operations. We note that this possibility does not change our argument that customers' short interest serves as a useful signal for suppliers' investment decisions. It does, however, affect the inference regarding whether a customer's short sellers adversely affect the customer's own investment efficiency, which is beyond the scope of our paper.

arbitrage and investors' limited information processing ability. For instance, Francis et al. (2008) find that short interest can predict future stock returns up to six months. Hence, the information in customers' short interest is unlikely to be subsumed by contemporaneous share price movements.

Is the information in customers' short interest subsumed by the supplier's own information? The supplier likely constantly searches for information about the customers that may help with its investment and operational decisions; the sources can include customers' financial statements, public disclosures, industrial news, and private communication with customers.¹³ It is possible that information contained in short positions of the customer firms overlaps to certain extent with the information that the supplier already has. However, customers' short interest is likely to have incremental information value above and beyond what the supplier already knows, because short sellers conduct their own independent research and the supplier can benefit from short sellers' private information acquisition and skilled processing of public information. In addition, even if the information in short interest confirms the supplier's own information, it is still valuable to the supplier as a means to verify and validate information.

In sum, the adverse news conveyed through short sales regarding the customer's operations or financial reporting is useful to suppliers' investment decisions. Such information likely has incremental information value, i.e., not yet subsumed by contemporaneous share price movements or the supplier's own information.¹⁴ This leads to our main hypothesis, stated below in the alternative form:

¹³ In Section 5, we explicitly address the concern that the information in customers' short interest may be correlated with the information from private communication between the customer and the supplier.

¹⁴ Our arguments should not be affected by the fact that short sellers typically have short investment horizons. What is important for the information value is that short sales reveal adverse news regarding customer's fundamentals and correct customer's overvaluation, even if on average short sellers do not hold short positions for long.

H1: *Suppliers adjust future investments downward in response to customers' current short positions.*

There are countervailing forces that work against us finding support for H1. As mentioned earlier, short sellers may take position in a firm simply for hedging purpose or for exploiting temporary price decline in the future. If these are the primary forces driving short sales, short interest may not be relevant for assessing customers' fundamental business. In addition, even if a customer's short interest is indicative of deteriorating business prospects, the supplier may be reluctant to adjust its investments due to frictions in the product market (such as contractual commitments, costs of losing a well-established business relationship, or unavailability of alternative business partners).

2.2 Cross-sectional Hypotheses

To lend further credence to the main hypothesis and to provide additional insights, we conduct several cross-sectional analyses. For this purpose, we focus on our key argument that a customer's short interest is useful to its supplier's investment decision because the customer's short interest has *incremental* information value regarding the customer's *fundamentals*. It thus follows that the effect of a customer's short interest on its supplier's investments will be stronger in cases (i) where the customer's short interest is more likely to have incremental information value, and (ii) where the customer's short interest is more likely to indicate issues relating to business fundamentals.¹⁵

¹⁵ While there are potentially other cross-sectional tests that can be run, our focus is on the key argument related to the information in customer's short interest and cases where we can make directional predictions. For example, we can potentially examine the role of customers' importance or suppliers' asset specificity. When the customer is more important, the customer's short interest likely has weaker effect on the supplier's investment decision, as the supplier may engage in more information acquisition of its own. On the other hand, when the customer is more important, the customer's short interest indicates greater hold-up problem, which can motivate the supplier to more aggressively cut down investments to alleviate potential losses. Similarly, high asset specificity exacerbates the potential hold-up problem, which motivates suppliers to react more strongly to customers' short interest. On the other hand, high asset specificity is often associated with well-established business relationship, which weakens suppliers' incentive to cut relationship-specific investments. Because of the opposite predictions, we do not formally examine customers' importance or suppliers' asset specificity in cross-sectional tests. In untabulated analyses, we

First, as mentioned above, suppliers resort to a variety of information sources to evaluate their customers' business fundamentals. Suppliers' information, therefore, can overlap with the information contained in short interest, potentially diluting the information value of customers' short interest. *Ceteris paribus*, when customers have opaque information environment and volatile business operations, suppliers face great difficulty in gathering and analyzing information to evaluate customers' business fundamentals. In such scenarios, short sellers' information is more useful for suppliers to evaluate and validate projections about customers' business fundamentals. Put in another way, short sellers' superior ability in acquiring and processing information are more likely to enhance the incremental and unique information value in customer's short interest in such cases.

Second, while short position on average conveys negative news about firm fundamentals, short position can also be taken to hedge risk or exploit anticipated temporary price decline and as a result, does not imply long-lasting deterioration in customers' fundamentals. We argue that this is less likely to occur when short interest is persistent, since repeatedly strong short sales likely precede a prolonged deterioration in customers' business fundamentals and anticipation of temporary price decline does not justify such a trading strategy.

The above discussions suggest that customers' short interest has a greater effect on suppliers' investment decisions when customers have opaque information environment and volatile business operations and when customers' short interest is more persistent. This leads to the following hypotheses, stated in the alternative form:

H2a: *The negative association between customers' current short positions and suppliers' future investments is stronger for customers with more opaque information environment.*

find that customers' short interest has a lower adverse effect on suppliers' investments when customers contribute more sales to suppliers (proxy for customer importance) and have greater R&D expenditures (proxy for suppliers' asset specificity).

H2b: *The negative association between customers' current short positions and suppliers' future investments is stronger for customers with more volatile business operations.*

H2c: *The negative association between customers' current short positions and suppliers' future investments is stronger when customers' short position is more persistent.*

3. Sample, Variables, and Descriptive Statistics

3.1. Sample Selection

According to SFAS 14, public issuers need to disclose the identities of major customers in annual reports (with the exception of small businesses filing 10-KSB).¹⁶ These disclosures are collected and compiled in Compustat Segment files, from which we identify a sample of supplier-customer-quarter observations with valid firm identifier (GVKEY) for both the suppliers and their reported customers between 1988 and 2011. We start from 1988 because our analysis on investment efficiency requires cash flow data that is available since 1987. We end the sample period in 2011 to facilitate the measurement of future investments of the supplier firms. We exclude cases where either suppliers or major customers operate in utility industry (SIC code 4000-5000) or financial industry (SIC code 6000-7000). When a supplier firm reports more than one major customer, we keep the principal customer, defined as the customer to whom the supplier firm makes the greatest sales in the year.

We collect short interest data from CRSP monthly files, where a firm's short interest is reported as the total number of outstanding short positions on the last trading day on or before the 15th of each month.¹⁷ For each supplier-customer-quarter observation, we search for short

¹⁶ According to SFAS 14 (paragraph 39), a major customer is defined as any customer whose purchases represent at least ten percent of an issuer's consolidated revenue and if the loss of the customer would have a material adverse effect on the issuer and its subsidiaries. While SFAS 14 was superseded by SFAS 30 in 1979 and SFAS 131 in 1997, the disclosure requirement about major customers remains.

¹⁷ Note that the CRSP data comes from the stock exchanges. The members of the stock exchanges are required to compile and report to the exchanges the outstanding short interest by the 15th of each month. The exchanges then aggregate the information and disclose the short interest of individual firms to the public within a week thereafter. Hence, the supplier should be able to observe the customer's short interest in a timely fashion.

interest in the customer's common stock reported closest to the fiscal quarter end. Our results remain qualitatively similar if we take the average of short interest reported over the entire quarter. Following Boehmer, Huszar, and Jordan (2010), we require that a customer's stock has been listed for at least one year, thereby excluding initial public offerings (IPOs) and other new listings. In our sample, we find that over 80% of major customers have positive short positions. We then merge with Compustat quarterly files and CRSP stock return files to obtain a sample of 16,448 supplier-customer-quarter observations with required financial data for the suppliers and major customers from 1988-2011.

3.2. Customers' Short Interest and Suppliers' Investment

In hypothesis testing, we use total short interest as well as self-constructed abnormal short interest in major customers' equity. Total short interest, *CUSTOMER_SHORT*, is the number of outstanding short positions of the customer firm (reported closest to the end of quarter t) divided by total common shares outstanding at the beginning of quarter t . Abnormal short interest, *ABN_CUSTOMER_SHORT*, is intended to remove the portion of total short interest that is attributed to market-level, industry-level, and inter-temporal shorting sentiments. The reason for this adjustment is that suppliers' investment activities may be driven by macro-level shocks that are reflected in customers' total short interest, as opposed to customers' own fundamental performance. To construct *ABN_CUSTOMER_SHORT*, we regress customers' short interest (*CUSTOMER_SHORT*) on market-level aggregate short interest, together with industry and year-quarter fixed effects. The regression residuals measure the abnormal portion of short interest in customers' equity that is unrelated to macro-level factors.¹⁸

¹⁸ In an additional analysis (untabulated), we follow Boehmer et al. (2010) to construct abnormal short interest controlling for the following variables: market-level short positions, total sales, return on assets, leverage, bid-ask spread, market-to-book ratio, return volatility, NYSE listing status, trading volume, put option trading, and the presence of large ownership (greater than 5%) by hedge fund, private equity, mutual fund, pension fund, or

We predict that upon observing major customers' short positions, suppliers will actively adjust corporate investments in anticipation of customers' changing business conditions. Our first measure of suppliers' investments is inventory production/purchase (*LEADIQ_INV*), defined as inventory production/purchase in quarter $t + 1$ divided by beginning total inventory. Production or purchase of inventories depends critically on suppliers' expectation about customers' near-term demand. Our second and third measures relate to suppliers' relationship-specific investments, including intangible and tangible asset investments. Following Raman and Shahrur (2008), we measure intangible relationship-specific investments (*LEADY_RD*) using total research and development expenditures over the next four quarters (quarter $t + 1$ to quarter $t + 4$) scaled by beginning total assets. We measure suppliers' tangible relationship-specific investments (*LEADY_CPX*) using total capital expenditures over the next four quarters scaled by beginning total assets. Note that R&D expenditures and capital expenditures are measured over the subsequent four quarters, because relationship-specific investments typically require a longer adjustment period than working capital investments.

3.3. Descriptive Statistics

Table 1, Panel A reports descriptive statistics for the sample. On a quarterly basis, suppliers' inventory production/purchases are on average more than three times the beginning inventory, suggesting fast inventory turnover. Over four quarters, R&D expenditure represents 5.3% of total assets, and capital expenditure accounts for 12.3% of total assets. On average, short interest accounts for 2.9% of common shares outstanding of the customers. The abnormal short interest in the customers is on average -1.4%.

insurance company. We obtain qualitatively similar results using this alternative model specification to derive abnormal short interest. We do not use this alternative specification for the main analyses because of its additional data requirement and the resulting loss of observations.

Table 1, Panel B provides univariate comparisons, conditional on whether the abnormal short interest in the customer is greater or less than the sample median. We find that, as predicted, suppliers' investments (*LEADIQ_INV*, *LEADY_RD*, and *LEADY_CPX*) are significantly lower for the sub-sample where *ABN_CUSTOMER_SHORT* is greater than the sample median. Since suppliers' investment activities are correlated with suppliers' and customers' characteristics, we next turn to multivariate regression analysis to assess the incremental effect of customers' short interest on suppliers' investment activities.

4. Main Analyses and Cross-sectional Analyses

4.1. Empirical Model

We specify the following regression model to examine the relation between customers' short interest and suppliers' investment activities:

$$LEAD_INVEST_i = \alpha_0 + \alpha_1 ABN_CUSTOMER_SHORT_i + \sum \alpha_k Controls_{i,k} + \varepsilon_i \quad (1)$$

The dependent variable, *LEAD_INVEST*, measures suppliers' investment activities following customers' short interest, defined as *LEADIQ_INV*, *LEADY_RD*, and *LEADY_CPX*, respectively. Our variable of interest is customers' abnormal short interest (*ABN_CUSTOMER_SHORT*). We also examine customers' total short interest (*CUSTOMER_SHORT*) in the empirical analysis. Since we expect customers' short interest to have a negative impact on suppliers' investments, we predict α_1 to be negative.

To isolate the unique information value of customers' short interest, we include three groups of variables to control for various factors that may affect suppliers' investment activities and customers' short positions, as well as alternative information sources available to the suppliers.

The first group of variables captures the business interdependence between customers and suppliers, measured by customer importance (*CU_IMPT*) and the duration of the customer-supplier relationship (*DURATION*). Greater customer importance implies greater bargaining power by the customers, leading to a higher inventory level of the suppliers in order to satisfy customers' procurement needs. Greater customer importance and longer customer-supplier relationship also strengthen the business commitments by both parties and therefore, suppliers are more likely to devote substantial relationship-specific investments to foster the business relationship.

The second group of variables includes various firm characteristics for suppliers. We control for supplier's own short position (*SUPPLIER_SHORT* or *ABN_SUPPLIER_SHORT*), as prior studies find that short selling plays a governance role in disciplining managers' overinvestment behavior (Chang, Lin, and Ma 2014). We include investment intensity in the current period (*INVT*, *RD_RATIO*, *CPX_RATIO*, respectively) to capture time trend in corporate investments. We also include suppliers' firm size (*SALE*), operating performance (*ROA* and *LOSS*), stock performance (*ABRET*), and firm growth (*MTOB* and *SALES_GROWTH*). Larger firms, more profitable firms, and growth firms tend to build a higher inventory buffer and greater production capacity in preparation for strong sales and uncertain business environment. On the other hand, performance reversal suggests a negative correlation between current firm performance and suppliers' future investments. In addition, we control for suppliers' life cycle, proxied by firm age (*FIRMAGE*), firm risk, proxied by market beta (*BETA*), and sales volatility (*STDSALE*). We expect that older firms and less risky firms have more stable operations and mature products, and such firms require a lower level of inventory production/purchases and less active corporate investments. We further include inventory lead time (*LEAD_TIME*) to account

for the effect of inventory buffer on future inventory production/purchase. Longer inventory lead time is often associated with a higher inventory buffer, leading to lower future inventory production/purchases.

Lastly, we add asset tangibility (*PPE_RATIO*) and an indicator variable to identify durable goods industry (*DURABLE*). More tangible assets may reduce the need to further expand production capacity, and firms from durable goods industry generally face higher customer-switching costs and hence are more likely to support existing customers by making more relationship-specific investments.

The third group of control variables considers relevant firm characteristics for major customers, including customers' firm size (*CU_SALE*), operating performance (*CU_ROA*), stock performance (*CU_ABRET*), sales growth (*CU_SALEGROWTH*), and sales volatility (*CU_STDSALE*). In general, when customers have superior performance and less volatile operations, their suppliers likely have greater inventory production/purchases and make more relationship-specific investments.

Suppliers can learn about customers' fundamentals from alternative information sources other than short interest (such as financial analysts' earnings forecasts). These alternative information sources may correlate with customers' short interest, leading to a spurious relationship between suppliers' investments and customers' short interest. To the extent that stock prices adequately incorporate alternative information sources, including customers' stock performance (*CU_ABRET*) in the regression model mitigates this concern. We further include customers' earnings growth in the subsequent quarter (*CU_LEAD_EPSGROWTH*) and the existence of analysts following the customer firms (*CU_DANALYST*) as additional controls, assuming that alternative information about customers' fundamentals is reasonably captured by

future realized performance and analyst reports.

Finally, we include year-quarter and industry fixed effects to account for inter-temporal changes in investments and industry-level factors. The Appendix provides detailed variable definitions.

4.2. Empirical Results

Table 2 reports the estimation results for equation (1). We report regression results based on both customers' total short interest (Panel A) and abnormal short interest (Panel B). Consistent with our prediction, we find significantly negative coefficients on both *CUSTOMER_SHORT* and *ABN_CUSTOMER_SHORT* across all three measures of suppliers' investments. Coefficients on *ABN_CUSTOMER_SHORT* are generally larger in magnitude than coefficients on *CUSTOMER_SHORT*, suggesting that suppliers' investment decisions respond more strongly to firm-specific information contained in customer's short interest that is unrelated to macro-level factors.

In terms of economic significance, based on the estimation results in Panel B of Table 2, changing customers' abnormal short interest from the first quartile (-3.114%) to the third quartile (0.015%) would reduce suppliers' inventory production/purchases by 10.5% ($= 3.129 \times -0.0334$) of beginning inventory, which translate into \$15.2 million ($= 10.5\% \times \144.42 million, the average balance of beginning inventory). Likewise, an inter-quartile change in customers' short interest (3.129%) reduces suppliers' intangible investments by 0.59% ($= 3.129 \times -0.0019$) of total assets, which are equivalent to \$19.6 million ($= 0.59\% \times \3317.72 million, the average total assets). The economic significance is similar for tangible asset investments. These results suggest that customers' short interest has economically meaningful impact on suppliers' investments.

It is possible that the reduction in inventory production/purchases reflects mechanical or passive responses to customers' declining purchase orders, given that customers' short interest may accompany slowing customer demand. Although we cannot directly observe customers' purchase orders, in untabulated analyses, we find a stronger (weaker) effect of customers' short interest on suppliers' inventory reduction when customers experience above (below) sample median sales growth. This finding is inconsistent with suppliers reducing inventories in response to customers' declining sales (and presumably fewer inventory orders). On the contrary, it indicates that customer short interest alerts suppliers to potential problems in customers' future business, and prompts suppliers to proactively adjust inventories before the declining performance materializes.¹⁹

With respect to control variables, suppliers' future inventory production/purchases are positively correlated with firm size ($\log(SALE)$), growth opportunities ($MTOB$), firm risk ($BETA$), customers' sales growth ($CU_SALEGROWTH$), and customers' future earnings growth ($CU_LEAD_EPSGROWTH$), and negatively correlated with firm age ($\log(FIRMAGE)$) and the presence of financial analysts following customers ($CU_DANALYST$). These results are consistent with suppliers' incentives to build a higher inventory buffer in anticipation of strong sales and uncertain business environment. In addition, the negative coefficients on suppliers' current profitability (ROA) and inventory lead time ($\log(LEAD_TIME)$) are consistent with performance reversals and less need to further build the inventory level because longer inventory lead time is often associated with a high level of existing inventories.

We observe somewhat different results on the control variables when examining relationship-specific investments. For instance, customer importance (CU_IMPT) increases

¹⁹ Consistent with our argument that customers' short interest indicates potential adverse changes in customers' business, we find that both customers' future sales growth and subsequent customer importance (measured as the proportion of supplier's total sales made to the customer) declines with current short interest in customers.

intangible and tangible investments, but longer customer-supplier relationship ($\log(DURATION)$) is negatively associated with tangible investments. While suppliers' own short interest ($ABN_SUPPLIER_SHORT$) has a negative impact on inventory production/purchases, its effect on tangible investments is positive, suggesting that suppliers actively undertake tangible investments to alleviate potential negative perceptions induced by strong short interest.

4.3. Instrument Variable Approach to Address Endogeneity

Although we include a battery of control variables in the OLS regression, it remains possible that the negative relation between customers' short interest and suppliers' investments is driven by omitted variables that correlate with both negative news in customer firms and suppliers' investment opportunities. Further, reverse causality may confound our analysis in that short sellers may take their positions in anticipation of the suppliers' reduction in relationship-specific investments targeted towards the customers.^{20, 21}

We employ an instrumental variable (IV) approach to mitigate such endogeneity concerns. We propose two exogenous factors that are correlated with customers' short interest, namely, the supply of lendable shares ($LENDABLE_PCT$) and the stock exchange listing choice ($NYSE$). Lendable shares represent the maximum amount of shares that are available to short, which should be positively correlated with the actual amount of shares being shorted (Desai, Ramesh, Thiagarajan, and Balachandran 2002; Boehmer et al. 2006). Moreover, short selling

²⁰ In theory, insiders in supplier firms can short customers' stocks before they decide to cut relationship-specific investments. However, this is unlikely in practice, because short sellers are predominantly institutional investors who are much better able to handle the risks associated with short selling than individual investors.

²¹ To address the possibility that short sellers may respond to suppliers' investment reduction in deciding to short customers' equity, we examine the association between customers' short interest (reported toward the end of quarter t) and suppliers' contemporaneous investments (during quarter t for inventory production/purchases and over four quarters ending with quarter t for R&D and capital expenditures). We do not find consistent evidence supporting negative associations. This casts some doubt on the reverse causality concern in that short sellers of customers do not seem to react to suppliers' past or concurrent investment reduction when taking short positions.

constraints, and hence the level of short interest, can be different for stocks listed on New York Stock Exchange versus those listed on American Stock Exchange and Nasdaq. Consistent with our intuition, in Table 3, the first-stage results show that the two instrumental variables are both positively associated with short interest in customer firms. The Kleibergen-Paap LM test strongly rejects the null of no correlation between the IVs and customers' short interest (p value < 0.01), suggesting that the instrumental variables satisfy the relevance criterion of valid IVs.

We expect that they also satisfy the exogeneity criterion in that they are unlikely to directly affect suppliers' investment decisions. First, lendable shares largely depend on institutional investors' security lending preferences and are likely unobservable by suppliers' management. Second, the choice of stock exchange listing was determined at the time of the IPO, far before suppliers' investment decisions are made. Empirically, we indeed find insignificant correlations between the IVs and second-stage regression residuals; the Hansen's J-test is insignificant ($p = 0.435$). These statistics support the argument that the instrument variables are exogenous.

The last three columns of Table 3 report the regression results based on the IV estimation. The significantly negative coefficients on the instrumented *CUSTOMER_SHORT* are consistent with OLS regression results.²² These results lend further credence to the causal effect of customers' short interest on suppliers' investment decisions.

Kecskes et al. (2013) use extreme short interest (or short interest "spike") as an instrumental variable in testing whether short sellers provide valuable information to investors in the bond market. They argue that extreme short interest largely reflects sudden exogenous negative news of a firm, as opposed to news anticipated by market participants or

²² Note that the sample size in the IV estimation (Table 3) is much smaller than that in the OLS estimation (Table 2), because data on lendable shares is not available prior to 2006.

contemporaneous news correlated with short positions. Following their approach, in untabulated tests, we include two indicator variables to identify observations ranked above the top quartile or below the bottom quartile of customers' abnormal short interest in the sample. We find that suppliers significantly reduce investments in inventory, R&D, and capital expenditures, following extremely high (above top quartile) abnormal short interest in customers' equity. On the other hand, suppliers maintain similar investment activities subsequent to extremely low (below bottom quartile) abnormal short interest in customers' equity. To the extent that short interest "spike" effectively captures exogenous shocks to customers' equity, these results reinforce our hypothesized causal effect of customers' short interest on suppliers' investment decisions.

4.4. Cross-sectional Analysis

4.4.1 Incremental information value of customer's short interest

H2a and H2b hypothesize that suppliers place greater weight on customers' short interest when they face greater difficulty in assessing customers' business fundamentals (in particular, when customers have greater information opacity and operational uncertainty) and hence customer's short interest is more likely to have incremental information value. We measure information opacity using information acquisition cost (*CU_INFCOST*) based on Duchin, Matsusaka, and Ozbas (2010). We first rank the three dimensions of information acquisition cost, namely, analyst forecast dispersion, analyst forecast error, and the number of analysts following a firm (reverse ranking). We then construct a composite index that ranges from zero to one by averaging each firm's percentile ranking in the sample for the three dimensions. A higher index value suggests greater information opacity. We measure operational uncertainty based on sales

volatility (*CU_STDSALE*), calculated as the standard deviation of customers' sales over the past 12 quarters.

Table 4, Panel A presents the estimation results for equation (1) conditional on *CU_INFCOST*. Consistent with our expectation, we find that the negative relation between *ABN_CUSTOMER_SHORT* and suppliers' investments is statistically significant in the subsample with above median value of *CU_INFCOST*, but is insignificant in the subsample with below median value of *CU_INFCOST*. Table 4, Panel B reports the regression results conditional on *CU_STDSALE*. Again, we find consistent evidence that relatively high sales volatility in customers strengthens the negative relation between *ABN_CUSTOMER_SHORT* and suppliers' investments. These results support our prediction that information opacity and operational uncertainty in customers magnifies the informational value of customers' short positions in influencing suppliers' investment decisions.

4.4.2 Persistence of customers' short interest

In H2c, we predict that the effect of customers' short interest on suppliers' investments is stronger when customers' short interest is more persistent. Our premise is that strong short interest over a longer horizon is more likely to be driven by fundamental deficiencies in customers' business operations. We compute average monthly abnormal short interest over the past three years (*PERS_ABNCUSTOMER_SHORT*), and re-estimate equation (1) after partitioning the sample based on the median value of *PERS_ABNCUSTOMER_SHORT*. Table 5 reports the estimation results. As shown, the coefficients on *ABN_CUSTOMER_SHORT* are significantly negative only when short interest is persistently high in the recent past.²³ This

²³ To alleviate the concern that high *PERS_ABNCUSTOMER_SHORT* might be driven by a few short interest "spike", we repeat the analysis conditional on both *PERS_ABNCUSTOMER_SHORT* and the standard deviation of monthly abnormal short interest over the past three years (*STD_CUSTOMER_SHORT*). Conditional on *PERS_ABNCUSTOMER_SHORT* being above-median, the results are significantly stronger for the observations

finding supports our prediction that persistently strong short positions in customers' equity severely reduce suppliers' confidence about customers' fundamentals, leading to reduced inventory production/purchases and lower investments in relationship-specific assets.

5. Additional Analyses

5.1. Addressing the Concern of Private Communication along the Supply Chain

Our analysis so far suggests that suppliers react to short interest in customers' equity when adjusting corporate investments. One alternative explanation for our findings is that customers' short interest simply captures unfavorable information suppliers already obtained through private communication with their customers. This is plausible, but unlikely to explain away our results. Prior research suggests that customers have incentives to communicate favorable or optimistic information to suppliers, leading to biased and incomplete communication along the supply chain. For instance, Cachon and Lariviere (2001) suggest that customers have incentives to bias demand forecasts upwards to induce suppliers to build excess capacity. This benefits the customers since suppliers can provide more goods if realized demand exceeds the initial forecast, but hurts suppliers since building excess capacity is costly (Leung 2012). To the extent that short sellers have superior ability in collecting and processing information and are incentivized to uncover negative news, the information in customer's short interest can help suppliers scrutinize private communication with customers and detect potential biases.

We design an indirect test to further alleviate the concern of private communication along the supply chain. We postulate that customers' private communication with their suppliers, on

with below-median *STD_CUSTOMER_SHORT* than for the observations with above-median *STD_CUSTOMER_SHORT*. These results reinforce the inference that more persistent short interest in customers' equity is more informative about customers' fundamentals, which prompts suppliers to make more investment adjustments.

average, should be directionally consistent with their public disclosures. This assumption is reasonable since customers face reputation costs and risks of losing business partners if the information privately conveyed to suppliers contradicts public disclosures. If information contained in short interest merely serves as a surrogate for (unfavorable) information that has been privately communicated from customers to suppliers, our results should be driven by the subsample where customers convey negative news to the public and presumably suppliers as well. In contrast, if customers' short interest reveals negative information above and beyond the private communication from customers to suppliers, our results should be more pronounced when customers convey positive news to the public, which contradicts the information underlying strong short interest in the customers' equity.

To measure the news contained in customers' public disclosure, we use news content in customers' earnings guidance (*CU_CIGNEWS*) and discretionary accrual choices (*CU_DACC*) in the current quarter. Table 6, Panel A reports the results conditional on whether *CU_CIGNEWS* is positive (good news) or negative (bad news). We find significant coefficients on *ABN_CUSTOMER_SHORT* only for the subsample having good news management forecasts. Table 6, Panel B reports the results conditional on the sign of *CU_DACC*. Firms with positive *CU_DACC* convey favorable information to the market through income-increasing discretionary accruals, and vice versa. Again, we find significantly negative coefficients on *ABN_CUSTOMER_SHORT* only for the subsample with positive *CU_DACC*.

Taken together, the findings in Table 6 suggest that short positions in customers' equity have greater adverse effects on suppliers' investments when customers disclose favorable information to market participants (presumably, favorable information to suppliers as well). Such

evidence suggests that private communication with suppliers is unlikely to fully subsume the information value of customers' short interest in affecting suppliers' investment decisions.

5.2. Addressing the Concern of Measurement Noise

5.2.1 *Measurement noise in short interest – excluding customers in the major index*

While we are interested in short interest taken in association with customers' declining fundamentals, short sellers may take positions for hedging purpose, thereby introducing noises to our tests. To mitigate this measurement noise, we re-do our analyses by excluding observations with customers being part of the major index (S&P 1500), because firms in the major index are much more likely to be shorted for hedging needs.²⁴ As reported in Table 7, our inferences remain unchanged.

5.2.2 *Measurement noise in investments – wealth transfer along the supply chain*

In the empirical tests, we use firm-level aggregate investments to infer adjustments in customer-level investments (i.e., investments targeted toward major customers who attract strong short interest). This measurement noise potentially weakens our findings, as firms may shift business from customers attracting strong short interest towards other customers with better fundamentals, thus disguising investment reductions in relation to the deteriorating customers. To further alleviate this concern, we examine the wealth transfer effect from major customers to their suppliers (e.g., Hertz et al. 2008). If suppliers reduce investments targeted towards customers with strong short interest, we would expect a weaker wealth transfer effect along the supply chain, due to reduced exposure to the customer's business.

Empirically, we first measure suppliers' responsiveness to customers' short interest based on the correlations between suppliers' future investments (*LEADIQ_INV*, *LEAD1Y_RD*, and

²⁴ This is due to the popularity of ETFs (exchange-traded funds) in hedging strategies, which tend to utilize part of the major index.

LEAD1Y_CPX) and customers' current short interest (*ABN_CUSTOMER_SHORT*) over a rolling window of the past 20 quarters. We then create an indicator variable; it equal to one for firms that are identified to react to customers' short interest by reducing investments and hence have negative correlations (*NEG_CORR_PUR* or *NEG_CORR_RD* or *NEG_CORR_CPX*), and zero otherwise. Following prior studies (e.g., Cohen and Frazzini 2008; Hertz et al. 2008), we regress suppliers' abnormal stock performance (*ABRET*) on customers' abnormal stock performance (*CU_ABRET*), adding the indicator variable and its interaction with *CU_ABRET*.

Table 8 reports the estimation results. Consistent with wealth transfer from customers to suppliers, we find a positive and significant coefficient on *CU_ABRET*. More importantly, the interaction term between *CU_ABRET* and *NEG_CORR_PUR* is significantly negative, suggesting that suppliers, by cutting inventory production/purchases in response to customers' short positions, significantly reduce their risk exposure to customers' business and weaken the wealth transfer from declining customers. The sum of *CU_ABRET* and its interaction with *NEG_CORR_PUR* remains significantly positive (F-statistics is significant at the $p < 0.01$ level). Thus, at least over the short horizon, suppliers bear negative consequences, albeit to a less extent, from customers' declining performance. This is intuitive since over the short horizon, it is costly to cut business ties with declining customers. Replacing *NEG_CORR_PUR* with *NEG_CORR_RD* or *NEG_CORR_CPX* yields similar results.

5.3. Customers' Short Interest and Suppliers' Investment Efficiency

Although reducing the reliance on customers' business via cutting investments can shield suppliers from customers' declining business, such behavior can also cause suppliers to lose trust of business partners and potentially limit suppliers' business opportunities. Moreover, speculative short selling can induce firm managers to make inefficient investment decisions and

destroy firm value (e.g., Goldstein and Guembel 2008), and this argument can extend to the firm's business partners as well (suppliers, in particular). In this section, we investigate whether suppliers' investment adjustments following customers' short interest improve the overall investment efficiency for the supplier firms.

Following prior studies (e.g., Beatty, Liao, and Yu 2013), we evaluate investment efficiency by regressing future realized cash flows (in year $t + 2$ or $t + 3$) on current capital expenditure (in year $t + 1$), after the supplier observes the customer's short interest. A larger positive coefficient on current capital expenditure suggests that each dollar of capital expenditure generates higher future cash flows, indicating higher payoffs from investment projects and hence, more efficient investment decisions.²⁵

Table 9 reports the estimation results, conditional on whether $CORR_{CPX}$ is less than or greater than the sample median, with $CORR_{CPX}$ defined as the Pearson correlation over the past 20 quarters between capital expenditure (over the next four quarters following customers' short interest) and customers' abnormal short interest. A more negative correlation indicates more aggressive reduction in investments following strong short interest in customers' equity. As shown, for both subsamples with below-median and above-median $CORR_{CPX}$, the coefficients on capital expenditure are significantly positive, consistent with supplier firms on average investing in positive net present value (NPV) projects. Importantly, the positive coefficients on capital expenditure are significantly larger when suppliers more aggressively cut investments following customers' short interest (i.e., $CORR_{CPX} \leq \text{Median}$). Hence, suppliers' reduced exposure to customers' business through investment adjustments does not detract from the overall corporate

²⁵ This methodology is less appropriate for inventory production/purchase and R&D expenditures due to the relatively short payoff horizon of inventory production/purchase and the large variation in the payoff horizon of R&D projects. Empirically, the Pearson correlations between future cash flows (over the next two or three years) and inventory/R&D investments are negative, reflecting the empirical challenge in measuring the payoff horizon of inventory and R&D investments.

investment efficiency. On the contrary, at least over the intermediate term (the next two or three years), suppliers are able to realize greater cash flows from capital investments.

6. Conclusion

We examine the effect of short selling on real investment decisions by business partners. Prior studies predominantly focus on the role of short selling in facilitating price discovery and curbing managerial misconduct, with limited evidence concerning the real impact of short sellers on stakeholders (in particular suppliers). Our maintained premise is that short sales convey negative information to suppliers regarding their customers' business fundamentals. If suppliers rely on customers' short sales in decision making, they would choose to reduce inventory production/purchases in anticipation of customers' declining demand. If suppliers perceive fundamental deficiencies in their customers' business, they would also curtail relationship-specific investments to reduce risk exposure to customers' business. Our empirical results strongly support these predictions.

Further, we document that following customers' strong short interest, suppliers more aggressively adjust investments downward when customers have more opaque information environment and more uncertain business operations, when customers' short interest is more persistent, and when customers' management releases more optimistic public disclosures. Suppliers who actively cut investments in response to customers' short position face reduced wealth transfer from their (deteriorating) customers and experience better investment efficiency in subsequent periods. The overall evidence supports the notion that short interest provides valuable information to business partners in making investment decisions.

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APPENDIX Variable Definition

Suppliers' investment-related variables

Main tests

LEAD1Q_INV Total inventory production/purchase in quarter $t + 1$ divided by total inventory at the beginning of quarter $t + 1$, where total inventory production/purchase is calculated as ending balance of inventory in quarter $t + 1$ plus total cost of goods sold in quarter $t + 1$ minus beginning balance of inventory in quarter $t + 1$.

LEAD1Y_RD Research and development expenses over quarter $t + 1$ to quarter $t + 4$, scaled by total assets in quarter t .

LEAD1Y_CPX Capital expenditures over quarter $t + 1$ to quarter $t + 4$, scaled by total assets in quarter t .

Additional tests

NEG_CORR_{PUR}
(*NEG_CORR_{RD}* or
NEG_CORR_{CPX}) A dummy variable that equals one if the Pearson correlation between *ABN_CUSTOMER_SHORT* and *LEAD1Q_INV* (*LEAD1Y_RD* or *LEAD1Y_CPX*) over a rolling window of the past 20 quarters is negative, and zero otherwise.

CORR_{CPX} Pearson correlation between *LEAD1Y_CPX* and *ABN_CUSTOMER_SHORT* over a rolling window of the past 20 quarters.

LEAD2Y_CFO Cash flow from operations over quarter $t + 5$ to quarter $t + 8$, divided by total assets in quarter t .

LEAD3Y_CFO Cash flow from operations over quarter $t + 9$ to quarter $t + 12$, divided by total assets in quarter t .

Customers' short interest-related variables

Main tests

CUSTOMER_SHORT The short position of the major customer firm reported closest to the quarter-end divided by the total number of shares outstanding at the beginning of the quarter.

ABN_CUSTOMER_SHORT The abnormal short position of the major customer firm reported closest to the quarter-end. It is the residual value from regressing *CUSTOMER_SHORT* on the aggregate market-level short interest using all firms in Compustat, together with industry and year-quarter fixed effects.

Cross-sectional tests

PERS_ABNCUSTOMER_SHORT The average abnormal short interest of the major customer firm in the past 36 months.

Instrumental variables

LENDABLE_PCT The percentage of the amount of shares available for lending reported closest to the quarter-end divided by the total number of shares outstanding at the beginning of the quarter for the major customer firm.

NYSE A dummy variable that equals one if the customer is listed on New York Stock Exchange, and zero if the customer is listed on American Stock Exchange or NASDAQ.

Other regression and partitioning variables

Supply chain characteristics

<i>CU_IMPT</i>	The relative importance of the customer to the supplier firm in the fiscal year of quarter <i>t</i> , measured as the total sales made to the major customer during the year divided by the supplier's total annual sales.
<i>DURATION</i>	The number of years the supplier and the customer has been in the relationship.
<i>Suppliers' firm characteristics</i>	
<i>SUPPLIER_SHORT</i>	The short position of the supplier firm reported closest to the quarter-end divided by the total number of shares outstanding at the beginning of the quarter.
<i>ABN_SUPPLIER_SHORT</i>	The abnormal short position of the supplier firm reported closest to the quarter-end. It is the residual value from regressing the short position of the supplier firm (<i>SUPPLIER_SHORT</i>) on the aggregate market-level short interest using all firms in Compustat, together with industry and year-quarter fixed effects.
<i>INV</i>	Total inventory production/purchase in quarter <i>t</i> divided by total inventory at the beginning of quarter <i>t</i> , where total inventory production/purchase is calculated as ending balance of inventory in quarter <i>t</i> plus total cost of goods sold in quarter <i>t</i> minus beginning balance of inventory in quarter <i>t</i> .
<i>RD_RATIO</i>	Research and development expenses over quarter <i>t</i> - 4 to quarter <i>t</i> , scaled by beginning total assets.
<i>CPX_RATIO</i>	Capital expenditures over quarter <i>t</i> - 4 to quarter <i>t</i> , scaled by beginning total assets.
<i>SALE</i>	Total sales in quarter <i>t</i> .
<i>ROA</i>	Earnings before extraordinary items for quarter <i>t</i> , scaled by total assets at the beginning of quarter <i>t</i> .
<i>LOSS</i>	A dummy variable that equals one if earnings before extraordinary items for quarter <i>t</i> is negative, and zero otherwise.
<i>ABRET</i>	Suppliers' market-adjusted buy-and-hold stock return, calculated as supplier's stock return minus the value-weighted market return for quarter <i>t</i> .
<i>MTOB</i>	Market value of equity divided by book value of equity at the end of quarter <i>t</i> .
<i>SALE_GROWTH</i>	Growth of total sales from quarter <i>t</i> - 1 to quarter <i>t</i> .
<i>FIRMAGE</i>	The age of the firm at the end of quarter <i>t</i> , measured as the number of years the firm has been in CRSP.
<i>BETA</i>	The slope coefficient from estimating Sharpe's (1964) market model using daily return data in year <i>t</i> - 1.
<i>STDSALE</i>	Sales volatility, calculated as the standard deviation of total sales over the last 12 quarters.
<i>LEAD_TIME</i>	$365 / (4 \times \text{cost of goods sold of quarter } t / \text{average accounts payable of quarter } t)$.
<i>PPE_RATIO</i>	Property, plant and equipment divided by total assets at the end of quarter <i>t</i> .
<i>DURABLE</i>	A dummy variable that equals one if the supplier firm operates in the durable manufacturing industry (SIC code between 1000 to 4783), and zero otherwise.

Customers' firm characteristics

<i>CU_SALE</i>	Customers' total sales in quarter t .
<i>CU_ROA</i>	Customers' earnings before extraordinary items for quarter t , scaled by total assets at the beginning of quarter t .
<i>CU_ABRET</i>	Customers' market-adjusted buy-and-hold stock return, calculated as customer's stock return minus the value-weighted market return for quarter t .
<i>CU_SALEGROWTH</i>	Customers' sales growth from quarter $t - 1$ to quarter t .
<i>CU_STDSALE</i>	Customers' sales volatility, calculated as the standard deviation of total sales over the last 12 quarters.
<i>CU_LEAD_EPSGROWTH</i>	Customers' leading EPS growth, measured as the actual EPS in quarter $t + 1$ minus EPS in quarter t , scaled by absolute value of EPS in quarter t .
<i>CU_DANALYST</i>	A dummy variable that equals one if the customer firm is followed by at least one analyst in the year of quarter t , and zero otherwise.
<i>Cross-sectional tests</i>	
<i>CU_INFACOST</i>	A measure of information acquisition cost in the year prior to quarter t . Following Duchin et al. (2010), we first create an information cost index by averaging the percentile rank of analyst following (reverse ranking), analyst forecast dispersion, and analyst forecast error. We then scale the index so that it ranges from zero (low information cost) to one (high information cost).
<i>Additional tests</i>	
<i>CU_CIGNEWS</i>	News contained in management forecast for the customer firm in quarter t . It is calculated as the latest management forecast of EPS minus the consensus analyst forecast immediately prior to the issuance of the management forecast, scaled by the stock price at the beginning of the quarter.
<i>CU_DACC</i>	The discretionary accruals for the customer firm for quarter t , where the discretionary accruals are estimated based on the modified Jones model, following Hutton, Marcus, and Tehranian (2009).
<i>Variables for the wealth transfer test</i>	
<i>MARKET</i>	The market factor in the Fama and French (1993) three-factor model.
<i>SMB</i>	The size factor in the Fama and French (1993) three-factor model.
<i>HML</i>	The book-to-market factor in the Fama and French (1993) three-factor model.
<i>UMD</i>	The momentum factor as in Carhart (1997).

TABLE 1: Summary Statistics

This table provides the descriptive statistics for the variables that are used in the main analyses (Panel A) and the comparative statistics between firm-quarter observations with *ABN_CUSTOMER_SHORT* above and below the sample median value (Panel B). Definitions of the variables are in the Appendix. In Panel B, ***, **, and * indicate significance at the $p < 0.01$, < 0.05 , and < 0.10 levels, respectively, based on two-tailed t (z) test statistics.

Panel A: Descriptive Statistics

Variables	N	Mean	Median	Q1	Q3	Std.
Suppliers' investment variables						
<i>LEAD1Q_INV</i>	16,448	3.692	1.401	0.832	2.794	9.572
<i>LEAD1Y_RD</i>	16,448	0.053	0.014	0.000	0.074	0.089
<i>LEAD1Y_CPX</i>	16,448	0.123	0.077	0.042	0.141	0.153
<i>LEAD2Y_CFO</i>	16,448	0.129	0.158	0.017	0.292	0.322
<i>LEAD3Y_CFO</i>	14,058	0.131	0.158	0.018	0.290	0.312
Customers' short interest variables						
<i>CUSTOMER_SHORT (%)</i>	16,448	2.858	1.256	0.777	2.629	3.325
<i>ABN_CUSTOMER_SHORT (%)</i>	16,448	-1.404	-2.289	-3.114	0.015	2.858
<i>PERS_ABNCUSTOMER_SHORT (%)</i>	16,448	0.039	-0.505	-1.467	0.859	2.130
<i>LENDABLE_PCT (%)</i>	7,468	22.38	22.50	16.63	27.52	8.50
Supply chain characteristics						
<i>CU_IMPT</i>	16,448	0.183	0.140	0.100	0.213	0.133
<i>DURATION (in years)</i>	16,448	5.821	5.000	2.000	9.000	6.911
Supplier firm characteristics						
<i>SUPPLIER_SHORT (%)</i>	16,448	4.294	2.082	0.381	5.592	6.092
<i>ABN_SUPPLIER_SHORT (%)</i>	16,448	1.235	0.000	-1.564	2.856	3.931
<i>SALE (in million dollars)</i>	16,448	121.79	765.93	32.10	484.25	2317.07
<i>ROA</i>	16,448	0.002	0.011	-0.002	0.021	0.049
<i>LOSS</i>	16,448	0.272	0.000	0.000	1.000	0.445
<i>ABRET</i>	16,448	0.042	0.016	-0.100	0.143	0.302
<i>MTOB</i>	16,448	2.803	1.952	1.310	3.131	2.958
<i>SALES_GROWTH</i>	16,448	0.051	0.025	-0.060	0.114	0.290
<i>FIRMAGE (in years)</i>	16,448	28.96	21.83	14.00	36.00	21.83
<i>BETA</i>	16,448	1.399	1.210	0.616	1.997	1.167
<i>STDSALE</i>	16,448	0.212	0.167	0.109	0.268	0.155
<i>LEAD_TIME (in days)</i>	16,448	61.44	43.47	30.03	63.33	47.13
<i>PPE_RATIO</i>	16,448	0.261	0.188	0.095	0.356	0.224
<i>DURABLE</i>	16,448	0.379	0.000	0.000	1.000	0.485
Customer firm characteristics						
<i>CU_SALE (in million dollars)</i>	16,448	9977.00	21366.02	2710.31	22554.00	28687.21
<i>CU_ROA</i>	16,448	0.015	0.017	0.008	0.024	0.023
<i>CU_ABRET</i>	16,448	0.006	0.016	-0.058	0.061	0.126
<i>CU_SALEGROWTH</i>	16,448	0.033	0.020	-0.039	0.092	0.495
<i>CU_STDSALE</i>	16,448	0.146	0.119	0.088	0.172	0.101
<i>CU_LEAD_EPSGROWTH</i>	16,448	0.075	0.028	-0.237	0.368	3.027
<i>CU_DANALYST</i>	16,448	0.923	1.000	0.000	1.000	0.266

TABLE 1: (Cont'd)

Panel B: Comparative Descriptive Statistics

Variables	Mean	Median	Mean	Median	t-test	z-test
	<i>ABN_CUSTOMER_SHORT</i> > median (N =8,219)		<i>ABN_CUSTOMER_SHORT</i> <= median (N = 8,229)			
Suppliers' investment variables						
<i>LEAD1Q_INV</i>	3.384	1.398	3.999	1.406	-4.12***	0.23
<i>LEAD1Y_RD</i>	0.045	0.008	0.061	0.018	-11.51***	-14.30***
<i>LEAD1Y_CPX</i>	0.112	0.071	0.134	0.086	-9.37***	-11.14***
<i>LEAD2Y_CFO</i>	0.133	0.149	0.126	0.165	1.30	-3.56***
<i>LEAD3Y_CFO</i>	0.135	0.154	0.127	0.162	1.43	-1.90*
Customers' short interest variables						
<i>CUSTOMER_SHORT</i> (%)	3.884	2.320	1.126	0.999	57.07***	54.96***
<i>ABN_CUSTOMER_SHORT</i> (%)	0.510	0.000	-3.317	-3.114	115.65***	111.19***
<i>PERS_ABNCUSTOMER_SHORT</i> (%)	1.188	0.574	-1.069	-1.345	53.55***	48.38***
<i>LENDABLE_PCT</i> (%)	25.14	12.42	7.02	5.99	10.08***	44.20***
Supply chain characteristics						
<i>CU_IMPT</i>	0.175	0.130	0.193	0.150	-8.50***	-13.46***
<i>DURATION</i> (in years)	5.287	4.000	6.433	5.000	-10.88***	-11.03***
Supplier firm characteristics						
<i>SUPPLIER_SHORT</i> (%)	4.011	1.612	4.538	2.477	-5.56***	-12.66***
<i>ABN_SUPPLIER_SHORT</i> (%)	1.116	-0.001	1.343	-0.089	-15.65***	2.96***
<i>SALE</i> (in million dollars)	576.89	103.73	955.54	146.32	-10.52***	-9.67***
<i>ROA</i>	0.003	0.011	0.001	0.011	2.57**	0.59
<i>LOSS</i>	0.268	0.000	0.277	0.000	-1.23	-1.23
<i>ABRET</i>	0.041	0.016	0.043	0.016	-0.40	-0.17
<i>MTOB</i>	2.617	1.849	2.988	2.087	-8.05***	-9.84***
<i>SALES_GROWTH</i>	0.050	0.024	0.053	0.025	-0.68	-0.77
<i>FIRMAGE</i> (in years)	27.085	22.000	30.831	26.000	-11.05***	-12.15***
<i>BETA</i>	1.453	1.277	1.344	1.128	5.96***	8.82***
<i>STDSALE</i>	0.209	0.165	0.215	0.169	-2.69***	-2.08**
<i>LEAD_TIME</i> (in days)	63.441	42.117	59.450	45.371	0.75	-4.76***
<i>PPE_RATIO</i>	0.297	0.215	0.225	0.166	21.02***	18.54***
<i>DURABLE</i>	0.391	0.000	0.367	0.000	3.16***	3.16***
Customer firm characteristics						
<i>CU_SALE</i> (in million dollars)	7,979	3,763	34,736	18,973	-67.70***	-68.49***
<i>CU_ROA</i>	0.012	0.013	0.019	0.019	-20.49***	-29.95***
<i>CU_ABRET</i>	0.012	0.003	0.000	0.004	5.76***	-3.96***
<i>CU_SALEGROWTH</i>	0.041	0.022	0.024	0.018	2.25**	1.01
<i>CU_STDSALE</i>	0.163	0.136	0.130	0.110	20.99***	21.50***
<i>CU_LEAD_EPSGROWTH</i>	0.046	0.030	0.104	0.027	-1.22	1.21
<i>CU_DANALYST</i>	0.879	1.000	0.968	1.000	-21.87***	-21.56***

TABLE 2: Customer Short Interest and Supplier Investments

This table provides the regression analyses linking customer short interest and supplier investment decisions. The sample includes all firm-quarter observations with available data from 1988-2011. Panel A presents the regression results for customer total short interest (*CUSTOMER_SHORT*); Panel B presents the results for customer abnormal short interest (*ABN_CUSTOMER_SHORT*). Definitions of the variables are in the Appendix. ***, **, and * indicate significance at the $p < 0.01$, < 0.05 , and < 0.10 levels, respectively, based on two-tailed t -test statistics clustered at the firm level.

Panel A: Total Customer Short Interest and Supplier Investments

VARIABLES	LEADIQ_INV	LEAD1Y_RD	LEAD1Y_CPX
	(1)	(2)	(3)
Constant (β_0)	1.9744*** (3.01)	0.0522** (2.53)	-0.1031** (-2.56)
CUSTOMER_SHORT (β_1)	-0.0185** (-2.49)	-0.0009*** (-3.26)	-0.0012** (-2.12)
CU_IMPT (β_2)	-0.0685 (-0.15)	0.0361*** (5.92)	0.0469** (2.63)
log(DURATION) (β_3)	0.0306 (0.71)	-0.0029*** (-2.83)	-0.0039* (-2.05)
SUPPLIER_SHORT (β_4)	-0.0094* (-1.85)	0.0003** (2.62)	0.0012*** (5.00)
INV (β_5)	0.7887*** (41.99)		
RD_RATIO (β_6)		0.0000 (0.99)	
CPX_RATIO (β_7)			0.0000* (1.74)
log(SALE) (β_8)	0.0722** (2.67)	-0.0046*** (-9.32)	-0.0013 (-0.71)
ROA (β_9)	-4.5426*** (-2.39)	-0.2632*** (-6.04)	0.0990** (2.50)
LOSS (β_{10})	-0.2381 (-1.66)	0.0133*** (4.30)	-0.0368*** (-8.27)
ABRET (β_{11})	-0.0863 (-0.26)	-0.0016 (-0.46)	-0.0005 (-0.13)
MTOB (β_{12})	0.0544** (2.51)	0.0074*** (9.78)	0.0048*** (6.91)
SALES_GROWTH (β_{13})	0.3440 (1.64)	0.0108*** (6.10)	0.0035 (0.84)
log(FIRMAGE) (β_{14})	-0.0865*** (-2.41)	-0.0079*** (-5.80)	-0.0024 (-1.03)
BETA (β_{15})	0.1068** (2.70)	0.0045*** (4.18)	0.0046** (2.14)
STDSALE (β_{16})	0.0843 (0.14)	-0.0149 (-1.56)	0.0223 (1.01)
log(LEAD_TIME) (β_{17})	-0.5709*** (-6.43)	0.0032* (1.76)	0.0140*** (3.94)
PPE_RATIO (β_{18})	-0.0683 (-0.16)	-0.0611*** (-5.69)	0.3746*** (12.69)
DURABLE (β_{19})	0.0149 (0.24)	0.0099*** (3.29)	0.0122*** (4.79)
log(CU_SALE) (β_{20})	0.0106 (0.61)	-0.0021** (-2.42)	-0.0004 (-0.26)
CU_ROA (β_{21})	1.8356 (0.56)	-0.0104 (-0.38)	0.0104 (0.28)
CU_ABRET (β_{22})	-0.6629 (-1.16)	0.0061 (1.14)	0.0038 (0.46)
CU_SALEGROWTH (β_{23})	0.4419*** (6.87)	0.0028*** (7.90)	0.0017*** (4.10)
CU_STDSALE (β_{24})	-0.0072 (-0.01)	0.0025 (0.27)	0.0391* (1.76)
CU_LEAD_EPSGROWTH (β_{25})	0.0367*** (2.86)	-0.0002 (-0.78)	0.0006* (1.80)
CU_DANALYST (β_{26})	-0.3621* (-2.01)	-0.0027 (-0.93)	-0.0153 (-1.55)

Industry, year- quarter fixed effects	Yes	Yes	Yes
Number of observations	16,448	16,448	16,448
Adjusted R-square	0.738	0.437	0.485

TABLE 2: (Cont'd)

Panel B: Abnormal Customer Short Interest and Supplier Investments

<i>VARIABLES</i>	<i>LEADIQ_INV</i>	<i>LEADIY_RD</i>	<i>LEADIY_CPX</i>
	(1)	(2)	(3)
Constant (β_0)	2.0841*** (3.36)	0.0590* (1.92)	-0.1024** (-2.51)
<i>ABN_CUSTOMER_SHORT</i> (β_1)	-0.0334*** (-3.66)	-0.0019*** (-3.70)	-0.0013** (-2.23)
<i>CU_IMPT</i> (β_2)	-0.0634 (-0.14)	0.0373** (2.52)	0.0478** (2.69)
$\log(\text{DURATION})$ (β_3)	0.0346 (0.80)	-0.0029 (-1.29)	-0.0042** (-2.19)
<i>ABN_SUPPLIER_SHORT</i> (β_4)	-0.0256** (-2.68)	0.0008 (1.64)	0.0021*** (5.18)
<i>INV</i> (β_5)	0.7882*** (42.02)		
<i>RD_RATIO</i> (β_6)		0.0000 (0.76)	
<i>CPX_RATIO</i> (β_7)			0.0000* (1.82)
$\log(\text{SALE})$ (β_8)	0.0787*** (2.89)	-0.0045*** (-3.36)	-0.0012 (-0.67)
<i>ROA</i> (β_9)	-4.5186** (-2.39)	-0.2624*** (-5.54)	0.0986** (2.48)
<i>LOSS</i> (β_{10})	-0.2417 (-1.68)	0.0133*** (4.17)	-0.0367*** (-8.32)
<i>ABRET</i> (β_{11})	-0.0823 (-0.25)	-0.0018 (-0.65)	-0.0009 (-0.24)
<i>MTOB</i> (β_{12})	0.0558** (2.54)	0.0073*** (6.96)	0.0047*** (6.76)
<i>SALES_GROWTH</i> (β_{13})	0.3433 (1.64)	0.0105*** (3.76)	0.0032 (0.77)
$\log(\text{FIRMAGE})$ (β_{14})	-0.0921** (-2.60)	-0.0078** (-2.49)	-0.0022 (-0.93)
<i>BETA</i> (β_{15})	0.1083** (2.74)	0.0044 (1.59)	0.0046** (2.14)
<i>STDSALE</i> (β_{16})	0.1162 (0.20)	-0.0154 (-1.10)	0.0224 (1.01)
$\log(\text{LEAD_TIME})$ (β_{17})	-0.5727*** (-6.42)	0.0032 (1.02)	0.0139*** (3.87)
<i>PPE_RATIO</i> (β_{18})	-0.0684 (-0.16)	-0.0613*** (-4.71)	0.3739*** (12.65)
<i>DURABLE</i> (β_{19})	0.0129 (0.20)	0.0103* (1.70)	0.0135*** (5.60)
$\log(\text{CU_SALE})$ (β_{20})	-0.0053 (-0.30)	-0.0030** (-2.13)	-0.0005 (-0.31)
<i>CU_ROA</i> (β_{21})	1.7229 (0.52)	-0.0212 (-0.28)	0.0067 (0.18)
<i>CU_ABRET</i> (β_{22})	-0.6742 (-1.18)	0.0064 (1.61)	0.0041 (0.50)
<i>CU_SALEGROWTH</i> (β_{23})	0.4434*** (7.02)	0.0030*** (6.23)	0.0019*** (4.48)
<i>CU_STDSALE</i> (β_{24})	-0.0322 (-0.06)	0.0022 (0.15)	0.0371 (1.69)
<i>CU_LEAD_EPSGROWTH</i> (β_{25})	0.0364*** (2.83)	-0.0002 (-0.76)	0.0006* (1.77)
<i>CU_DANALYST</i> (β_{26})	-0.3810** (-2.14)	-0.0039 (-0.79)	-0.0171 (-1.69)
Industry, year-quarter fixed effects	Yes	Yes	Yes
Number of observations	16,448	16,448	16,448
Adjusted R-square	0.738	0.439	0.485

TABLE 3: Controlling for Endogeneity of Customer Short Interest: Instrumental Variable Estimation

This table provides the regression analyses linking customer short interest and supplier investment decisions using the instrumental variable approach. In the first stage, we estimate customer short interest, *CUSTOMER_SHORT*. Columns (1)-(3) are the regression results based on the instrumented *CUSTOMER_SHORT* from the first stage regression. Definitions of the variables are in the Appendix. The sample includes all firm-quarter observations with available data from 1988-2011. ***, **, and * indicate significance at the $p < 0.01$, < 0.05 , and < 0.10 levels, respectively, based on two-tailed t -test statistics clustered at the firm level.

VARIABLES	First stage	(1)	(2)	(3)
	<i>CUSTOMER_SHORT</i>	<i>LEAD1Q_INV</i>	<i>LEAD1Y_RD</i>	<i>LEAD1Y_CPX</i>
Constant (β_0)	8.4927*** (4.36)	3.6526*** (3.86)	0.1557*** (7.48)	-0.1285*** (-4.89)
<i>LENDABLE_PCT</i> (μ_1)	0.0745*** (2.85)			
<i>NYSE</i> (μ_2)	0.6135* (1.70)			
<i>INSTUMENTED_CUSTOMER_SHORT</i> (β_1)		-0.0075* (-1.72)	-0.0017*** (-2.80)	-0.0023*** (-4.40)
<i>SUPPLIER_SHORT</i> (β_2)	0.0058 (0.89)	0.0018 (0.46)	0.0001 (1.43)	0.0005*** (4.12)
<i>INV</i> (β_3)		0.7993*** (10.93)		
<i>RD_RATIO</i> (β_4)			0.0000*** (7.30)	
<i>CPX_RATIO</i> (β_5)				0.0000** (2.04)
<i>CU_IMPT</i> (β_6)	0.7451 (0.81)	-1.1549** (-1.97)	0.0383*** (5.45)	0.0292*** (3.48)
<i>DURATION</i> (β_7)	0.0750 (0.84)	0.0346 (0.49)	-0.0055*** (-4.79)	-0.0051*** (-3.70)
$\log(\text{SALE})$ (β_8)	-0.0554 (-1.00)	-0.1360** (-2.13)	-0.0021*** (-2.96)	-0.0032*** (-3.88)
<i>ROA</i> (β_9)	1.5511 (1.05)	-2.4817 (-1.27)	-0.2244*** (-11.05)	0.0309 (1.27)
<i>LOSS</i> (β_{10})	0.1841 (1.10)	-0.1801 (-1.18)	0.0215*** (8.40)	-0.0216*** (-7.05)
<i>ABRET</i> (β_{11})	0.0631 (0.77)	-0.4853* (-1.88)	-0.0011 (-0.39)	-0.0026 (-0.76)
<i>MTOB</i> (β_{12})	-0.0388 (-1.43)	0.0340** (2.18)	0.0092*** (28.69)	0.0041*** (10.62)
<i>SALES_GROWTH</i> (β_{13})	0.1468 (1.40)	0.1052 (0.47)	0.0092*** (2.85)	0.0061 (1.58)
$\log(\text{FIRMAGE})$ (β_{14})	0.1089 (0.76)	-0.2344*** (-3.29)	-0.0113*** (-7.88)	-0.0071*** (-4.14)
<i>BETA</i> (β_{15})	-0.0907 (-1.19)	0.1298** (2.39)	0.0081*** (9.21)	0.0030*** (2.84)
<i>STDSALE</i> (β_{16})	-0.2113 (-0.39)	-0.0957 (-0.17)	0.0028 (0.44)	-0.0027 (-0.35)
$\log(\text{LEAD_TIME})$ (β_{17})	0.1085 (0.87)	-0.4985*** (-3.21)	0.0033** (2.22)	0.0196*** (11.14)
<i>PPE_RATIO</i> (β_{18})	1.1089 (1.26)	0.3298 (0.64)	-0.1148*** (-14.44)	0.4130*** (43.45)
<i>DURABLE</i> (β_{19})	-0.1558 (-0.51)	0.0331 (0.34)	0.0208*** (6.11)	0.0129*** (3.17)
$\log(\text{CU_SALE})$ (β_{20})	-0.8431*** (-5.94)	0.0335 (0.51)	-0.0071*** (-8.06)	0.0028*** (3.03)
<i>CU_ROA</i> (β_{21})	-11.6254* (-1.84)	-0.0849 (-0.02)	0.0162 (0.40)	-0.0368 (-0.76)
<i>CU_ABRET</i> (β_{22})	1.2140*** (2.72)	-0.8870 (-1.41)	0.0078 (1.06)	-0.0010 (-0.11)
<i>CU_SALEGROWTH</i> (β_{23})	-0.0405 (-0.94)	0.4670*** (21.55)	0.0023* (1.87)	0.0017 (1.15)
<i>CU_STDSALE</i> (β_{24})	1.6549 (1.03)	-0.9834 (-1.26)	-0.0233* (-1.94)	-0.0013 (-0.09)
<i>CU_LEAD_EPSGROWTH</i> (β_{25})	-0.0369 (-1.07)	0.0138 (0.63)	0.0002 (0.83)	0.0010*** (2.90)
<i>CU_DANALYST</i> (β_{26})	0.0598 (0.07)	0.0669 (0.29)	0.0055 (0.77)	0.0154* (1.80)

Industry, year-quarter fixed effects	Yes	Yes	Yes	Yes
Number of observations	7,208	7,208	7,208	7,208
Adjusted R-square	0.643	0.684	0.553	0.537

TABLE 4: The Role of Customer Information Opacity and Operational Uncertainty

This table provides the regression analyses on the effect of customer information cost and operational uncertainty on the relationship between customer short interest and supplier investment decisions. Panel A presents the regression results by partitioning the sample conditional on whether customer information cost (*CU_INFOCOST*) is above or below the sample median. Panel B partitions the sample conditional on whether customer sales volatility (*CU_STDSALE*) is above or below the sample median. Definitions of the variables are in the Appendix. The sample includes all firm-quarter observations with available data from 1988-2011. ***, **, and * indicate significance at the $p < 0.01$, < 0.05 , and < 0.10 levels, respectively, based on two-tailed t -test statistics clustered at the firm level.

Panel A: Customers' Information Opacity

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	<i>LEADIQ_INV</i>	<i>LEADIY_RD</i>	<i>LEADIY_CPX</i>	<i>LEADIQ_INV</i>	<i>LEADIY_RD</i>	<i>LEADIY_CPX</i>
	<i>CU_INFOCOST</i> > median			<i>CU_INFOCOST</i> ≤ median		
Constant (β_0)	2.9241** (2.75)	0.0609*** (3.24)	-0.0676 (-1.48)	1.5539*** (2.81)	0.0702** (2.20)	-0.1557*** (-3.27)
<i>ABN_CUSTOMER_SHORT</i> (β_1)	-0.0413** (-2.38)	-0.0017*** (-3.77)	-0.0016* (-1.98)	-0.0395 (-1.53)	-0.0019 (-1.51)	-0.0008 (-0.85)
<i>CU_IMPT</i> (β_2)	-0.6173 (-1.26)	0.0302*** (3.34)	0.0457** (2.20)	0.4812 (0.76)	0.0510*** (2.95)	0.0498** (2.33)
log(<i>DURATION</i>) (β_3)	0.0148 (0.22)	-0.0018 (-1.51)	-0.0034 (-1.16)	0.0486 (0.68)	-0.0050* (-1.96)	-0.0054 (-1.45)
<i>ABN_SUPPLIER_SHORT</i> (β_4)	-0.0295* (-1.76)	0.0008** (2.54)	0.0024*** (4.75)	-0.0185 (-1.54)	0.0007 (1.31)	0.0016*** (2.60)
<i>INV</i> (β_5)	0.7596*** (17.14)			0.8237*** (26.85)		
<i>RD_RATIO</i> (β_6)		0.0000 (1.48)			0.0000 (0.60)	
<i>CPX_RATIO</i> (β_7)			0.0000 (1.36)			0.0000* (1.84)
log(<i>SALE</i>) (β_8)	0.0752*** (2.84)	-0.0045*** (-6.42)	-0.0013 (-0.67)	0.0805 (1.56)	-0.0042*** (-2.80)	-0.0010 (-0.40)
<i>ROA</i> (β_9)	-4.6321* (-1.77)	-0.2184*** (-5.28)	0.0971 (1.55)	-3.9105* (-1.77)	-0.3061*** (-4.78)	0.0993* (1.96)
<i>LOSS</i> (β_{10})	-0.1836 (-1.14)	0.0183*** (5.34)	-0.0396*** (-6.50)	-0.2818 (-1.35)	0.0081** (2.10)	-0.0333*** (-6.39)
<i>ABRET</i> (β_{11})	-0.6036* (-1.85)	-0.0071** (-2.70)	-0.0026 (-0.52)	0.5417* (1.84)	0.0038 (0.86)	0.0016 (0.37)
<i>MTOB</i> (β_{12})	0.0863*** (2.95)	0.0076*** (9.40)	0.0049*** (5.74)	0.0138 (0.51)	0.0072*** (6.48)	0.0043*** (4.48)
<i>SALES_GROWTH</i> (β_{13})	0.3910 (1.31)	0.0110*** (3.66)	0.0052 (0.92)	0.2811 (1.13)	0.0090*** (2.91)	0.0005 (0.10)
log(<i>FIRMAGE</i>) (β_{14})	-0.1156** (-2.73)	-0.0098*** (-4.78)	-0.0056 (-1.64)	-0.0913 (-1.69)	-0.0065** (-2.22)	0.0012 (0.30)
<i>BETA</i> (β_{15})	0.1425*** (2.79)	0.0042*** (3.57)	0.0079*** (2.93)	0.0584 (0.86)	0.0040* (1.78)	0.0010 (0.40)
<i>STDSALE</i> (β_{16})	0.2841 (0.33)	-0.0264*** (-2.94)	0.0075 (0.27)	-0.0895 (-0.18)	-0.0042 (-0.26)	0.0379** (2.03)
log(<i>LEAD_TIME</i>) (β_{17})	-0.6114*** (-4.59)	0.0000 (0.01)	0.0146*** (3.24)	-0.4661*** (-4.21)	0.0072* (1.84)	0.0125** (2.03)
<i>PPE_RATIO</i> (β_{18})	0.1617 (0.26)	-0.0501*** (-4.01)	0.3704*** (12.43)	-0.4458 (-1.45)	-0.0750*** (-4.79)	0.3851*** (11.21)
<i>DURABLE</i> (β_{19})	0.0029 (0.04)	0.0071** (2.25)	0.0103*** (2.90)	0.0168 (0.26)	0.0129** (1.97)	0.0176** (2.35)
log(<i>CU_SALE</i>) (β_{20})	-0.0277 (-0.70)	-0.0014 (-1.33)	-0.0014 (-0.70)	-0.0040 (-0.11)	-0.0050*** (-2.98)	0.0010 (0.47)
<i>CU_ROA</i> (β_{21})	5.4542 (1.09)	-0.1277 (-1.38)	0.0446 (0.78)	-2.3720 (-0.96)	0.0624 (0.71)	-0.0053 (-0.08)
<i>CU_ABRET</i> (β_{22})	-1.3481 (-1.28)	0.0081 (1.39)	-0.0052 (-0.50)	-0.1613 (-0.35)	0.0035 (0.44)	0.0130 (1.32)
<i>CU_SALEGROWTH</i> (β_{23})	0.4465*** (8.70)	0.0025*** (10.57)	0.0014*** (3.78)	0.5875* (1.76)	0.0112** (2.34)	0.0046 (0.60)
<i>CU_STDSALE</i> (β_{24})	-0.3726 (-0.45)	0.0023 (0.29)	-0.0028 (-0.15)	-0.0018 (-0.00)	0.0025 (0.13)	0.0968* (1.87)
<i>CU_LEAD_EPSGROWTH</i> (β_{25})	0.0798*** (2.86)	-0.0007*** (-4.28)	0.0010* (1.73)	-0.0009 (-0.10)	0.0003 (1.14)	0.0002 (0.66)
<i>CU_DANALYST</i> (β_{26})	-0.8547* (-2.01)	-0.0081** (-2.42)	-0.0094 (-0.68)	-0.0962 (-0.46)	0.0018 (0.31)	-0.0217 (-1.39)
Industry, year-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	8,408	8,499	8,499	8,040	8,040	8,040
Adjusted R-square	0.717	0.446	0.487	0.768	0.447	0.496

TABLE 4: (Cont'd)

Panel B: Customers' Sales Volatility

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	LEADIQ_INV	LEADIY_RD	LEADIY_CPX	LEADIQ_I	LEADIY_RD	LEADIY_CPX
	CU STDSALE > median			CU STDSALE ≤ median		
Constant (β_0)	1.6402 (1.53)	0.0082 (0.25)	-0.1007** (-2.18)	2.4638** (2.34)	0.0708** (1.98)	-0.0988** (-2.13)
ABN_CUSTOMER_SHORT (β_1)	-0.0336** (-2.58)	-0.0024*** (-5.96)	-0.0017*** (-3.23)	-0.0307 (-1.64)	-0.0012 (-1.57)	-0.0000 (-0.00)
CU_IMPT (β_2)	-0.3923 (-0.42)	0.0360*** (3.39)	0.0691*** (6.05)	0.0705 (0.18)	0.0322* (1.90)	0.0283 (1.54)
log(DURATION) (β_3)	0.0746 (1.13)	0.0016 (1.03)	-0.0071*** (-3.37)	-0.0287 (-0.39)	-0.0074*** (-2.60)	-0.0024 (-0.77)
ABN_SUPPLIER_SHORT (β_4)	-0.0501*** (-4.16)	0.0006** (2.35)	0.0022*** (5.51)	-0.0053 (-0.44)	0.0008 (1.53)	0.0020*** (3.11)
INV (β_5)	0.7952*** (27.38)			0.7751*** (12.97)		
RD_RATIO (β_6)		0.0000 (0.19)			0.0000 (0.90)	
CPX_RATIO (β_7)			0.0000*** (6.25)			0.0000 (1.36)
log(SALE) (β_8)	0.0706** (2.25)	-0.0079*** (-10.92)	-0.0016 (-1.33)		-0.0022 (-1.45)	0.0006 (0.23)
ROA (β_9)	-5.7839* (-2.02)	-0.2528*** (-3.89)	0.0574 (1.62)	-3.4473** (-2.24)	-0.2715*** (-4.39)	0.1236*** (2.95)
LOSS (β_{10})	-0.2011 (-0.96)	0.0174*** (4.26)	-0.0489*** (-12.14)	-0.2472 (-1.60)	0.0100** (2.52)	-0.0233*** (-4.83)
ABRET (β_{11})	0.1467 (0.34)	-0.0077 (-1.62)	0.0040 (0.86)	-0.3321 (-1.33)	0.0041 (0.86)	-0.0053 (-1.01)
MTOB (β_{12})	0.0746* (1.82)	0.0093*** (7.93)	0.0062*** (11.00)	0.0474** (2.12)	0.0060*** (5.32)	0.0036*** (3.77)
SALES_GROWTH (β_{13})	0.4113 (0.96)	0.0111*** (3.30)	-0.0009 (-0.19)	0.3220 (1.22)	0.0107*** (2.77)	0.0064* (1.66)
log(FIRMAGE) (β_{14})	-0.1169** (-2.26)	-0.0086*** (-4.66)	-0.0064*** (-2.81)	-0.0732 (-1.03)	-0.0068* (-1.92)	-0.0025 (-0.69)
BETA (β_{15})	0.1549** (2.26)	0.0046** (2.69)	0.0059*** (4.37)	0.0431 (1.03)	0.0041 (1.49)	0.0033 (1.40)
STDSALE (β_{16})	-0.0043 (-0.00)	-0.0248* (-1.98)	0.0109 (1.07)	0.3221 (0.62)	0.0045 (0.27)	0.0277 (1.51)
log(LEAD_TIME) (β_{17})	-0.6442*** (-5.32)	0.0024 (0.81)	0.0265*** (11.68)	-0.5164*** (-3.44)	0.0043 (1.06)	-0.0005 (-0.12)
PPE_RATIO (β_{18})	0.6329 (0.80)	-0.0698*** (-4.18)	0.3943*** (35.33)	-0.6360 (-1.15)	-0.0533*** (-3.22)	0.3518*** (10.55)
DURABLE (β_{19})	0.0651 (0.80)	0.0192*** (5.71)	0.0071 (1.35)	0.0056 (0.06)	0.0016 (0.22)	0.0171** (2.04)
log(CU_SALE) (β_{20})	0.0418 (1.50)	-0.0016 (-1.14)	-0.0029** (-2.53)	-0.0017 (-0.05)	-0.0042** (-2.26)	0.0020 (0.84)
CU_ROA (β_{21})	5.2094 (1.27)	-0.0108 (-0.24)	-0.0224 (-0.41)	-4.4368** (-2.29)	-0.0011 (-0.01)	0.1412* (1.89)
CU_ABRET (β_{22})	-1.1734 (-1.35)	0.0092 (1.12)	0.0097 (0.99)	-0.0987 (-0.22)	0.0036 (0.63)	0.0013 (0.14)
CU_SALEGROWTH (β_{23})	0.2517 (0.61)	0.0075*** (3.00)	0.0006 (0.09)	0.4569*** (17.59)	0.0024*** (5.94)	0.0020*** (4.53)
CU_STDSALE (β_{24})	-0.2220 (-0.22)	0.0225 (1.68)	0.0508*** (3.58)	-1.6724 (-0.96)	-0.0785 (-1.23)	-0.0033 (-0.03)
CU_LEAD_EPSGROWTH (β_{25})	0.0680** (2.67)	-0.0004* (-1.82)	0.0007* (1.67)	0.0037 (0.57)	0.0002 (0.59)	0.0009** (2.30)
CU_DANALYST (β_{26})	-0.3644* (-1.71)	0.0066 (1.40)	-0.0217*** (-3.66)	-0.5064 (-1.13)	-0.0147** (-2.17)	0.0041 (0.29)
Industry, year-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	7,473	7,557	7,557	8,975	8,975	8,975
Adjusted R-square	0.728	0.472	0.521	0.758	0.436	0.480

TABLE 5: The Role of Persistence of Customer Short Interest

This table provides analyses on the role of the persistence of customer short interest on the relationship between customer short interest and supplier investment decisions. The sample includes all firm-quarter observations with available data from 1988-2011. Definitions of the variables are in the Appendix. ***, **, and * indicate significance at the $p < 0.01$, < 0.05 , and < 0.10 levels, respectively, based on two-tailed t -test statistics clustered at the firm level.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	LEADIQ INV	LEAD1Y RD	LEAD1Y CPX	LEADIQ INV	LEAD1Y RD	LEAD1Y CPX
	PERS ABNCUSTOMER SHORT > median			PERS ABNCUSTOMER SHORT ≤ median		
Constant (β_0)	1.4577** (2.46)	-0.0137 (-0.60)	-0.0241 (-0.40)	3.1924*** (3.84)	0.0707*** (4.85)	-0.1070*** (-4.03)
ABN_CUSTOMER_SHORT (β_1)	-0.0420** (-2.35)	-0.0024*** (-4.66)	-0.0021*** (-3.12)	-0.0114 (-0.26)	-0.0000 (-0.02)	0.0001 (0.12)
CU_IMPT (β_2)	0.0547 (0.13)	0.0070 (0.72)	0.0499* (2.03)	-0.0689 (-0.09)	0.0692*** (5.52)	0.0428** (2.21)
log(DURATION) (β_3)	-0.0429 (-0.78)	-0.0026** (-2.30)	-0.0032 (-1.15)	0.1271** (2.42)	-0.0025* (-2.04)	-0.0061* (-1.90)
ABN_SUPPLIER_SHORT (β_4)	-0.0432** (-2.46)	0.0004 (1.17)	0.0028*** (3.39)	-0.0219** (-2.21)	0.0010*** (4.65)	0.0014*** (4.48)
INV (β_5)	0.7437*** (20.41)			0.8087*** (30.30)		
RD_RATIO (β_6)		0.0000 (0.74)			0.0000* (1.97)	
CPX_RATIO (β_7)			0.0000 (1.64)			0.0000 (0.87)
log(SALE) (β_8)	0.1324** (2.61)	-0.0042*** (-4.59)	-0.0003 (-0.12)	0.0474 (1.27)	-0.0044*** (-6.53)	-0.0034** (-2.39)
ROA (β_9)	-3.6997*** (-3.73)	-0.2388*** (-4.65)	0.1630** (2.69)	-4.4674 (-1.62)	-0.2684*** (-6.88)	0.0244 (0.79)
LOSS (β_{10})	-0.2816** (-2.48)	0.0129*** (3.71)	-0.0446*** (-6.74)	-0.1534 (-0.70)	0.0123*** (3.18)	-0.0271*** (-6.77)
ABRET (β_{11})	0.0844 (1.37)	0.0051** (2.45)	0.0063* (1.76)	0.1499** (2.15)	0.0041*** (3.37)	0.0015 (1.29)
MTOB (β_{12})	-0.3826 (-1.51)	-0.0015 (-0.39)	0.0044 (0.58)	0.0763 (0.18)	-0.0033 (-0.76)	-0.0028 (-0.85)
SALES_GROWTH (β_{13})	-0.1136** (-2.65)	-0.0096*** (-4.33)	-0.0026 (-0.61)	-0.0483 (-0.76)	-0.0049*** (-3.34)	-0.0047* (-1.87)
log(FIRMAGE) (β_{14})	0.5570 (1.60)	-0.0329*** (-2.89)	0.0360 (1.48)	-0.4005 (-0.46)	0.0113 (0.87)	-0.0103 (-0.40)
BETA (β_{15})	0.0272* (2.06)	0.0073*** (6.08)	0.0047*** (5.65)	0.0845* (1.90)	0.0074*** (10.71)	0.0038*** (4.92)
STDSALE (β_{16})	0.3841* (1.71)	0.0080*** (4.24)	0.0024 (0.37)	0.2896 (0.84)	0.0133*** (5.41)	0.0039 (1.00)
log(LEAD_TIME) (β_{17})	-0.2110 (-0.56)	-0.0530*** (-3.41)	0.3672*** (10.83)	-0.2249 (-0.32)	-0.0760*** (-11.58)	0.3909*** (8.73)
PPE_RATIO (β_{18})	-0.5160*** (-4.90)	0.0054 (1.42)	0.0098 (1.51)	-0.6393*** (-4.89)	0.0002 (0.05)	0.0190*** (4.61)
DURABLE (β_{19})	0.0192 (0.41)	0.0092** (2.07)	0.0237*** (5.31)	0.0038 (0.05)	0.0099** (2.40)	0.0045 (1.44)
log(CU_SALE) (β_{20})	-0.0128 (-0.34)	-0.0006 (-0.68)	-0.0035 (-1.32)	0.0321 (0.79)	-0.0053*** (-4.12)	0.0031 (1.69)
CU_ROA (β_{21})	-0.2707 (-0.10)	-0.0362 (-0.56)	-0.0325 (-0.48)	4.5399 (0.44)	0.0145 (0.11)	0.1403 (1.51)
CU_ABRET (β_{22})	-0.4952 (-0.68)	0.0061 (1.22)	0.0082 (0.93)	-0.9475** (-2.34)	0.0079 (0.91)	-0.0085 (-0.81)
CU_SALEGROWTH (β_{23})	0.4494*** (11.16)	0.0030*** (12.24)	0.0016** (2.72)	0.3324 (0.39)	0.0096** (2.17)	0.0132** (2.21)
CU_STDSALE (β_{24})	-0.4897 (-0.90)	-0.0071 (-0.47)	0.0589** (2.34)	0.7438 (0.86)	0.0321** (2.29)	-0.0048 (-0.15)
CU_LEAD_EPSGROWTH (β_{25})	0.0160 (1.47)	0.0000 (0.01)	0.0005 (1.23)	0.0708* (2.08)	-0.0006 (-1.45)	0.0012*** (3.31)
CU_DANALYST (β_{26})	-0.0522 (-0.25)	-0.0060* (-1.84)	-0.0117 (-0.76)	-0.6816* (-2.05)	0.0083 (0.88)	-0.0292 (-1.57)
Industry, year- quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	8,428	8,632	8,632	9,020	9,020	9,020
Adjusted R-square	0.746	0.419	0.470	0.739	0.491	0.537

TABLE 6: Confounding Effect of Private Communication along the Supply Chain

This table provides the regression analyses to address the confounding effect of private communications along the supply chain on the association between customer short interest and supplier investments. We use two variables to proxy such private communication: (1) whether or not news contained in customers' management forecasts in quarter t is good news (forecasted earnings is greater than the consensus analyst forecast) or bad news (forecasted earnings is less than the consensus analyst forecast); and (2) whether discretionary accruals of the customer in quarter t is positive or negative. Results are presented in Panel A and B, respectively. The sample includes all firm-quarter observations with available data from 1988-2011; Panel A further requires the availability of management forecast and consensus analyst forecast. Definitions of the variables are in the Appendix. ***, **, and * indicate significance at the $p < 0.01$, < 0.05 , and < 0.10 levels, respectively, based on two-tailed t -test statistics clustered at the firm level.

Panel A: News in Customers' Management Forecasts

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	LEAD1Q_INV	LEAD1Y_RD	LEAD1Y_CPX	LEAD1Q_INV	LEAD1Y_RD	LEAD1Y_CPX
	CU_CIGNEWS > 0			CU_CIGNEWS ≤ 0		
Constant (β_0)	2.8931 (0.74)	0.1040 (1.61)	-0.0892 (-0.78)	-11.0797** (-2.22)	0.0578 (0.64)	0.0388 (0.39)
ABN_CUSTOMER_SHORT (β_1)	-0.0897* (-2.06)	-0.0075*** (-3.77)	-0.0018* (-1.79)	-0.0358 (-0.72)	-0.0028 (-1.35)	0.0011 (0.68)
CU_IMPT (β_2)	0.9539 (0.33)	0.0197 (0.60)	-0.1027** (-2.76)	-1.5389 (-1.06)	0.1161 (1.41)	0.0301 (0.78)
log(DURATION) (β_3)	0.4886 (1.16)	0.0016 (0.22)	0.0073 (0.89)	0.3310* (1.83)	0.0086 (1.00)	0.0076 (1.48)
ABN_SUPPLIER_SHORT (β_4)	-0.0572 (-0.95)	0.0001 (0.23)	0.0014 (1.38)	-0.0452 (-1.51)	-0.0001 (-0.23)	-0.0001 (-0.03)
INV (β_5)	0.7734*** (5.15)			0.7382*** (8.08)		
RD_RATIO (β_6)		0.0000** (2.18)			0.0000* (1.76)	
CPX_RATIO (β_7)			0.0000 (0.04)			0.0000 (0.17)
log(SALE) (β_8)	-0.0366 (-0.14)	-0.0025 (-0.68)	-0.0052 (-0.92)	-0.0171 (-0.10)	-0.0069** (-2.07)	-0.0028 (-0.84)
ROA (β_9)	-2.3785* (-1.76)	-0.0993 (-1.27)	0.1433 (1.41)	-0.8571 (-0.52)	-0.3267*** (-2.94)	0.0584 (0.81)
LOSS (β_{10})	-0.5302 (-0.62)	0.0268** (2.26)	-0.0266* (-1.96)	-0.0631 (-0.23)	0.0038 (0.35)	-0.0269*** (-3.12)
ABRET (β_{11})	-0.4912 (-0.42)	0.0217 (0.79)	0.0134 (0.77)	0.2231 (0.78)	-0.0008 (-0.09)	-0.0078 (-0.71)
MTOB (β_{12})	0.1457 (1.44)	0.0063*** (2.43)	0.0032 (1.28)	0.0126 (0.23)	0.0053*** (3.49)	-0.0001 (-0.09)
SALES_GROWTH (β_{13})	-0.1976 (-0.21)	0.0099 (0.91)	0.0099 (0.77)	0.3832 (0.91)	0.0201 (1.62)	0.0209 (1.55)
log(FIRMAGE) (β_{14})	-0.0499 (-0.24)	-0.0121 (-1.20)	-0.0063 (-1.13)	0.4613** (2.27)	-0.0041 (-0.33)	-0.0101 (-1.46)
BETA (β_{15})	-0.2526 (-0.82)	0.0154* (1.95)	-0.0063 (-0.71)	0.0541 (0.48)	0.0186** (2.14)	0.0054 (1.08)
STDSALE (β_{16})	-2.0993 (-1.48)	0.0150 (0.37)	-0.0433 (-1.39)	-3.6882* (-1.93)	0.0030 (0.06)	-0.0145 (-0.62)
log(LEAD_TIME) (β_{17})	0.1063 (0.47)	-0.0059 (-0.70)	0.0097 (0.89)	0.0352 (0.16)	0.0051 (0.43)	0.0034 (0.44)
PPE_RATIO (β_{18})	0.7239 (1.13)	-0.0058 (-0.14)	0.4246*** (6.78)	-0.0650 (-0.07)	-0.0725* (-1.78)	0.3540*** (5.11)
DURABLE (β_{19})	-0.1071 (-0.18)	0.0116 (0.71)	0.0165 (0.88)	0.4046 (1.23)	-0.0155 (-1.32)	0.0233*** (2.68)
log(CU_SALE) (β_{20})	-0.1596 (-1.03)	0.0009 (0.17)	-0.0104 (-0.92)	-0.1056 (-0.97)	-0.0040 (-0.88)	0.0012 (0.25)
CU_ROA (β_{21})	2.3889 (0.72)	0.3255* (1.90)	0.1555 (1.01)	1.3163 (0.55)	-0.2509 (-0.83)	-0.0554 (-0.44)

<i>CU_ABRET</i> (β_{22})	0.1633 (0.15)	0.0374 (1.32)	0.0747* (1.76)	1.6183* (1.81)	0.0106 (0.42)	0.0067 (0.25)
<i>CU_SALEGROWTH</i> (β_{23})	0.9885 (0.53)	0.0576** (2.31)	0.0494** (2.19)	0.4354 (0.55)	-0.0005 (-0.02)	0.0285 (1.14)
<i>CU_STDSALE</i> (β_{24})	-3.2660 (-1.34)	-0.1050 (-1.03)	0.1573 (1.22)	0.3889 (0.20)	-0.0425 (-0.46)	-0.0400 (-0.64)
<i>CU_LEAD_EPSGROWTH</i> (β_{25})	-0.0184 (-0.49)	0.0001 (0.13)	0.0013 (0.41)	0.0174 (0.42)	-0.0004 (-0.37)	0.0006 (0.67)
<i>CU_DANALYST</i> (β_{26})	0.0029 (0.00)	0.0240 (0.88)	0.0574** (2.52)	0.1757 (0.27)	-0.0057 (-0.22)	0.0139 (0.51)
Industry, year-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	426	426	426	663	663	663
Adjusted R-square	0.705	0.599	0.655	0.889	0.487	0.485

TABLE 6: (Cont'd)

Panel B: Customers' Discretionary Accruals

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	LEAD1Q_INV	LEAD1Y_RD	LEAD1Y_CPX	LEAD1Q_INV	LEAD1Y_RD	LEAD1Y_CPX
	CU_DACC > 0			CU_DACC ≤ 0		
Constant (β_0)	3.1096*** (3.43)	0.0675*** (2.92)	-0.0965* (-1.91)	1.3409 (1.26)	0.0429 (1.13)	-0.1216** (-2.39)
ABN_CUSTOMER_SHORT (β_1)	-0.0613*** (-3.42)	-0.0017*** (-4.55)	-0.0014* (-1.77)	-0.0209 (-0.83)	-0.0002** (-2.21)	-0.0010 (-1.03)
CU_IMPT (β_2)	0.2891 (0.66)	0.0279*** (3.67)	0.0600*** (3.10)	-0.4626 (-0.78)	0.0485*** (3.14)	0.0291 (1.52)
log(DURATION) (β_3)	0.0357 (0.47)	-0.0027* (-1.96)	-0.0039 (-1.50)	0.0295 (0.35)	-0.0033 (-1.32)	-0.0052 (-1.62)
ABN_SUPPLIER_SHORT (β_4)	-0.0133 (-0.88)	0.0006 (1.66)	0.0021*** (4.68)	-0.0418** (-2.43)	0.0008 (1.51)	0.0020*** (3.04)
INV (β_5)	0.8293*** (18.80)			0.7484*** (16.06)		
RD_RATIO (β_6)		0.0000 (0.79)			0.0000 (0.72)	
CPX_RATIO (β_7)			0.0000 (1.51)			0.0000 (1.61)
log(SALE) (β_8)	0.2892 (0.66)	0.0279*** (3.67)	0.0600*** (3.10)	-0.3666 (-0.64)	0.0485*** (3.14)	0.0275 (1.46)
ROA (β_9)	0.0357 (0.47)	-0.0027* (-1.96)	-0.0039 (-1.50)	0.0214 (0.25)	-0.0033 (-1.32)	-0.0051 (-1.58)
LOSS (β_{10})	0.0737* (1.80)	-0.0042*** (-7.30)	-0.0027 (-1.43)	0.0761 (1.35)	-0.0050*** (-3.18)	-0.0004 (-0.15)
ABRET (β_{11})	-5.5440** (-2.15)	-0.2199*** (-4.99)	0.1332** (2.45)	-3.4142 (-1.24)	-0.2888*** (-5.60)	0.0712* (1.69)
MTOB (β_{12})	-0.3140 (-1.57)	0.0165*** (5.40)	-0.0352*** (-7.18)	-0.1763 (-1.16)	0.0101** (2.53)	-0.0372*** (-6.86)
SALES_GROWTH (β_{13})	-0.0190 (-0.06)	0.0005 (0.10)	-0.0027 (-0.60)	-0.2566 (-1.03)	-0.0050 (-1.40)	0.0012 (0.26)
log(FIRMAGE) (β_{14})	0.0193 (1.06)	0.0070*** (9.79)	0.0057*** (6.01)	0.0964** (2.30)	0.0075*** (6.62)	0.0036*** (3.73)
BETA (β_{15})	0.2100 (0.83)	0.0113*** (3.81)	0.0015 (0.36)	0.4892 (0.94)	0.0098** (1.97)	0.0032 (0.62)
STDSALE (β_{16})	-0.0875 (-1.34)	-0.0073*** (-4.51)	-0.0002 (-0.07)	-0.0901 (-1.00)	-0.0084** (-2.56)	-0.0058 (-1.50)
log(LEAD_TIME) (β_{17})	0.0566 (0.89)	0.0054*** (3.43)	0.0047* (1.84)	0.1591*** (2.70)	0.0036 (1.61)	0.0044* (1.77)
PPE_RATIO (β_{18})	0.5766 (0.98)	-0.0150* (-1.85)	0.0234 (0.99)	-0.4519 (-0.53)	-0.0166 (-1.06)	0.0175 (0.91)
DURABLE (β_{19})	-0.5860*** (-3.81)	0.0024 (1.12)	0.0159*** (3.90)	-0.5538*** (-3.28)	0.0040 (1.05)	0.0120* (1.85)
log(CU_SALE) (β_{20})	-0.3798 (-0.77)	-0.0505*** (-4.31)	0.3432*** (10.55)	0.3846 (0.60)	-0.0735*** (-4.73)	0.4122*** (11.71)
CU_ROA (β_{21})	0.0273 (0.35)	0.0097*** (3.13)	0.0134*** (3.44)	-0.0311 (-0.28)	0.0120* (1.81)	0.0139** (2.34)
CU_ABRET (β_{22})	-0.0878** (-2.04)	-0.0044*** (-4.57)	-0.0015 (-0.72)	0.0533 (0.97)	-0.0011 (-0.62)	0.0004 (0.17)
CU_SALEGROWTH (β_{23})	-6.6499 (-1.26)	0.0683 (1.37)	-0.1564 (-1.71)	4.7255 (1.22)	-0.0477 (-0.58)	0.0613 (1.03)
CU_STDSALE (β_{24})	-1.3236** (-2.40)	-0.0016 (-0.31)	-0.0078 (-0.73)	-0.0921 (-0.18)	0.0129* (1.72)	0.0164* (1.77)
CU_LEAD_EPSGROWTH (β_{25})	0.4652*** (14.51)	0.0025*** (8.19)	0.0017*** (3.93)	-0.1702 (-0.42)	0.0074 (1.47)	0.0013 (0.19)
CU_DANALYST (β_{26})	-0.2880 (-0.35)	-0.0052 (-0.50)	0.0176 (0.56)	-0.2676 (-0.35)	0.0162 (0.90)	0.0499 (1.60)
Industry, year-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	8,677	8,773	8,773	7,771	7,771	7,771
Adjusted R-square	0.769	0.436	0.495	0.709	0.450	0.490

TABLE 7: Customer Short Interest and Supplier Investments Excluding Customers in the Major Index

This table provides the regression analyses linking customer short interest and supplier investment decisions after excluding observations when the customer is included in the S&P 1500 index. Definitions of the variables are in the Appendix. ***, **, and * indicate significance at the $p < 0.01$, < 0.05 , and < 0.10 levels, respectively, based on two-tailed t -test statistics clustered at the firm level.

VARIABLES	LEAD1Q INV	LEAD1Y RD	LEAD1Y CPX
	(1)	(2)	(3)
Constant (β_0)	3.1467** (2.51)	-0.0090 (-0.17)	0.0482 (0.86)
ABN_CUSTOMER_SHORT (β_1)	-0.0876*** (-2.84)	-0.0025** (-2.52)	-0.0013** (-2.25)
CU_IMPT (β_2)	0.7520 (0.54)	0.0391 (1.29)	0.0326 (0.77)
log(DURATION) (β_3)	0.1074 (1.09)	0.0040 (0.79)	-0.0006 (-0.10)
ABN_SUPPLIER_SHORT (β_4)	-0.0938*** (-5.40)	0.0005 (0.61)	0.0022** (2.74)
INV (β_5)	0.7500*** (13.35)		
RD_RATIO (β_6)		0.0000 (0.33)	
CPX_RATIO (β_7)			0.0000* (1.82)
log(SALE) (β_8)	0.0816 (1.51)	-0.0064** (-2.14)	-0.0006 (-0.12)
ROA (β_9)	-11.0379* (-1.83)	-0.2721*** (-3.43)	-0.0148 (-0.22)
LOSS (β_{10})	-0.3908 (-1.08)	0.0222*** (3.57)	-0.0552*** (-7.50)
ABRET (β_{11})	0.6942 (1.14)	-0.0059 (-1.49)	0.0082 (0.63)
MTOB (β_{12})	0.1129 (1.43)	0.0088*** (4.12)	0.0045*** (3.39)
SALES_GROWTH (β_{13})	0.7822 (1.07)	0.0072 (1.34)	-0.0011 (-0.14)
log(FIRMAGE) (β_{14})	0.0206 (0.19)	-0.0149 (-1.46)	-0.0157** (-2.14)
BETA (β_{15})	-0.1213 (-1.57)	0.0060 (0.89)	0.0119*** (3.58)
STDSALE (β_{16})	1.2123 (0.99)	-0.0538 (-1.58)	0.0018 (0.04)
log(LEAD_TIME) (β_{17})	-0.8298*** (-4.73)	0.0052 (0.96)	0.0288*** (4.25)
PPE_RATIO (β_{18})	0.2514 (0.36)	-0.0847*** (-3.25)	0.3620*** (6.83)
DURABLE (β_{19})	0.1039 (0.76)	0.0067 (0.62)	-0.0064 (-0.83)
log(CU_SALE) (β_{20})	0.0864 (1.66)	0.0018 (0.77)	-0.0010 (-0.44)
CU_ROA (β_{21})	6.3274* (1.86)	-0.0831 (-0.65)	0.0323 (0.47)
CU_ABRET (β_{22})	-1.4567 (-1.60)	0.0127* (1.70)	-0.0007 (-0.09)
CU_SALEGROWTH (β_{23})	0.4771*** (9.03)	0.0027*** (4.74)	0.0022*** (3.00)
CU_STDSALE (β_{24})	-0.5146 (-0.63)	0.0142 (0.55)	0.0963* (1.86)
CU_LEAD_EPSGROWTH (β_{25})	0.0832** (2.67)	-0.0003 (-0.91)	0.0008 (1.68)
CU_ANALYST (β_{26})	-0.5352* (-1.81)	-0.0017 (-0.22)	-0.0358* (-1.93)
Industry, year-quarter fixed effects	Yes	Yes	Yes
Number of observations	3,948	3,999	3,999
Adjusted R-square	0.709	0.516	0.501

TABLE 8: Customer Short Interest and Wealth Transfer Effect along the Supply Chain

This table provides the regression analyses on the mitigating effect of suppliers' investment strategy on the wealth transfer effect along a firm's supply chain, measured as the positive association between supplier's monthly abnormal return and customer's monthly abnormal return. The sample period is 1988-2011. NEG_CORR_{PUR} (NEG_CORR_{RD} or NEG_CORR_{CPX}) is a dummy variable that equals one if the Pearson correlation between $ABN_CUSTOMER_SHORT$ and $LEADIQ_INV$ ($LEAD1Y_RD$ or $LEAD1Y_CPX$) over a rolling window of the past 20 quarters is negative, suggesting that suppliers cut their investments in response to customer abnormal short interest, and zero otherwise. Definitions of all other variables are in the Appendix. ***, **, and * indicate significance at the $p < 0.01$, < 0.05 , and < 0.10 levels, respectively, based on two-tailed t -test statistics clustered at the firm level.

VARIABLES	Dependent variable: <i>ABRET</i>			
	(1)	(2)	(3)	(4)
Constant (β_0)	-0.0067* (-1.95)	-0.0063* (-1.82)	-0.0062* (-1.75)	-0.0058* (-1.67)
<i>CU_ABRET</i> (β_1)	0.2043*** (21.12)	0.2184*** (18.82)	0.2129*** (13.23)	0.2180*** (17.71)
<i>CUSTOMER_SHORT</i> (β_2)	-0.0002 (-1.49)	-0.0002* (-1.74)	-0.0002 (-1.46)	-0.0002 (-1.55)
<i>NEG_CORR_PUR</i> (β_3)		-0.0019* (-1.79)		
<i>CU_ABRET</i> × <i>NEG_CORR_PUR</i> (β_4)		-0.0392** (-1.99)		
<i>NEG_CORR_RD</i> (β_5)			-0.0007 (-0.66)	
<i>CU_ABRET</i> × <i>NEG_CORR_RD</i> (β_6)			-0.0123* (-1.73)	
<i>NEG_CORR_CPX</i> (β_7)				-0.0010 (-0.98)
<i>CU_ABRET</i> × <i>NEG_CORR_CPX</i> (β_8)				-0.0258* (-1.72)
$\log(\text{SALE})$ (β_9)	0.0023*** (8.12)	0.0023*** (8.18)	0.0023*** (8.13)	0.0023*** (8.14)
<i>MTOB</i> (β_{10})	0.0027*** (10.97)	0.0027*** (11.09)	0.0027*** (11.00)	0.0027*** (10.99)
<i>MARKET</i> (β_{11})	0.7780*** (43.79)	0.7782*** (43.81)	0.7778*** (43.83)	0.7787*** (43.90)
<i>SMB</i> (β_{12})	0.5531*** (21.39)	0.5513*** (21.26)	0.5534*** (21.38)	0.5520*** (21.33)
<i>HML</i> (β_{13})	0.2382*** (9.10)	0.2374*** (9.08)	0.2382*** (9.10)	0.2376*** (9.08)
<i>UMD</i> (β_{14})	-0.0589*** (-4.67)	-0.0588*** (-4.66)	-0.0589*** (-4.67)	-0.0589*** (-4.67)
F-test statistics for: $\beta_1 + \beta_4 = 0$ $\beta_1 + \beta_6 = 0$ $\beta_1 + \beta_8 = 0$		118.80***	293.06***	253.81***
Industry, year- quarter fixed effects	Yes	Yes	Yes	Yes
Number of observations	55,658	55,658	55,658	55,658
Adjusted R-square	0.216	0.216	0.216	0.216

TABLE 9: Customer Short Interest and Supplier Investment Efficiency

This table provides the regression analyses on suppliers' investment efficiency as a function of the responsiveness of their investment decisions to customer short interest. $CORR_{CPX}$ is the Pearson correlation between $LEAD1Y_CPX$ and $ABN_CUSTOMER_SHORT$ over a rolling window of the past 20 quarters. Definitions of all other variables are in the Appendix. The sample includes all firm-quarter observations with available data from 1988-2011. ***, **, and * indicate significance at the $p < 0.01$, < 0.05 , and < 0.10 levels, respectively, based on two-tailed t -test statistics clustered at the firm level.

VARIABLES	(1)	(2)	(3)	(4)
	$LEAD2Y_CFO$	$LEAD3Y_CFO$	$LEAD2Y_CFO$	$LEAD3Y_CFO$
	$CORR_{CPX} > \text{Median}$		$CORR_{CPX} \leq \text{Median}$	
Constant (β_0)	0.1189 (1.12)	-0.0664 (-0.44)	-0.3738*** (-3.40)	-0.3761*** (-3.86)
$LEAD1Y_CPX$ (β_1)	0.3440*** (2.82)	0.4298*** (3.36)	0.4511*** (3.04)	0.6027*** (4.65)
CU_IMPT (β_2)	-0.0577 (-0.72)	-0.0040 (-0.06)	-0.2405*** (-3.04)	-0.1868** (-2.27)
$\log(DURATION)$ (β_3)	0.0209 (1.48)	0.0143 (1.02)	0.0052 (0.46)	-0.0105 (-0.95)
$\log(SALE)$ (β_4)	0.0478*** (6.56)	0.0500*** (7.92)	0.0339*** (5.54)	0.0312*** (5.22)
ROA (β_5)	0.4977* (1.75)	0.9864*** (3.17)	0.4964** (2.45)	1.2003*** (5.28)
$LOSS$ (β_6)	-0.1041*** (-3.84)	-0.0778*** (-3.01)	-0.0926*** (-4.39)	-0.0738*** (-3.35)
$MTOB$ (β_7)	-0.0028 (-0.54)	-0.0015 (-0.31)	0.0026 (0.57)	0.0001 (0.04)
LEV (β_8)	0.0471 (0.77)	0.0222 (0.37)	0.1143* (1.89)	0.0601 (1.04)
$SALE_GROWTH$ (β_9)	-0.1007** (-2.09)	-0.0310 (-0.66)	-0.0294 (-0.85)	-0.0297 (-0.63)
$\log(FIRMAGE)$ (β_{10})	-0.0087 (-0.70)	-0.0131 (-1.08)	0.0113 (0.86)	0.0179 (1.51)
$DURABLE$ (β_{11})	0.0583 (1.30)	0.0849* (1.94)	-0.0370 (-0.68)	-0.0141 (-0.29)
Industry, year-quarter fixed effects	Yes	Yes	Yes	Yes
Number of observations	8,585	7,270	7,863	6,788
Adjusted R-square	0.248	0.265	0.211	0.224