The effect of stock prices on real investment in the supply chain

Ryan Williams[a], Steven Chong Xiao[b++]

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[a] Eller College of Management, University of Arizona, Tucson, AZ 85721
[b] Scheller College of Business, Georgia Institute of Technology, Atlanta, GA 30308

Abstract:

We investigate whether suppliers use information in customer stock prices. Using mutual fund price pressure to identify exogenous negative shocks to stock prices, we find evidence that suppliers decrease subsequent relationship-specific investments (RSI) following declines in their key customers' market values. Specifically, suppliers appear concerned that decreases in their customers' market values signal poor growth prospects for their customers, future decreases in their customers' own investment levels, and a higher probability of their customers becoming takeover targets. Thus, information in stock prices also affects investment decisions by other product market participants, implying that a better information environment in financial markets may help mitigate supply chain frictions.

[++] Contact information: rwilliams@email.arizona.edu and +1-520-621-2852 (Williams); and chong.xiao@scheller.gatech.edu and +1-404-385-5109 (Xiao). All errors are ours.

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Supplier investment decisions are linked to a variety of customer actions. For example, suppliers often make investment decisions specific to certain customers (relationship-specific investment, or RSI). These investments lose value outside of these specific relationships. Therefore, suppliers and customers often work together to preserve the value of their relationships. Extant literature documents that supplier RSI is affected by its customers' financial policies (Haugen and Senbet (1978, 1988), Titman (1984), Titman and Wessels (1988), Maksimovic and Titman (1991), Mackay and Philips (2005) and Kale and Shahrur (2007)); trade credit policies (Dass, Kale, and Nanda (2013)); accounting and contracting policies (Raman and Shahrur (2008), Costello (2013)); and the risk-taking incentives of CEOs (Kale, Kedia, and Williams (2013)).

Another factor that may influence a supplier's RSI decision are the stock valuations of its customers. The value of a supplier firm's RSI depends heavily on the economic prospects of its customers, which can be indicated by their stock market valuations. Studies have shown that stock prices can act as information sources that guide managers in making investment decisions and improve real efficiency (e.g. Chen, Goldstein, and Jiang (2007)). A firm's stock price likely also provides important information to its supply-chain partners, who have less insider information than the firm's own managers. In this paper, we study the informational role of stock prices to product market participants and ask whether firms glean information from their customers' stock prices for making their RSI decisions.

Many product market studies examine the relation between supplier RSI and a customer policy, or vice versa. As customer and supplier relationships exist in equilibrium, these studies often capture endogenous, *ex-ante* optimal arrangements between the two parties.[1] Clearly, the relation between

[1] Authors of previous studies are aware of this issue. We know of at least two other studies that consider shocks to the equilibrium supplier-customer relationship, although over a longer time horizon. Philips and Sertsios (2012) argue that firms experiencing sustained negative shocks have the incentive to renege on their implicit contracts, and present evidence that service quality decreases when firms enter financial distress. Kale, Meneghetti, and Shahrur (2012) show that product warranty-offering firms have lower debt levels than those who do not. However, following long-term negative growth, warranty-offering firms issue more debt than non-warranty firms. Alternatively, Foucault and Fresard (2013) study investment/Q sensitivity between a firm and its rivals. Their study approaches the endogeneity question differently. They develop a model and do not attempt to identify causality in their

customer stock prices and supplier RSI is also endogenous. For example, customer stock prices may reflect expected future levels of supplier RSI. To identify a causal relation between customer stock prices and supplier RSI, we follow Edmans, Goldstein, and Jiang (2012) and identify exogenous variation in customers' stock prices due to mutual fund flow-driven price pressure. Specifically, we capture exogenous downward movements in customer stock prices due to mutual fund flow-driven price pressure and examine the effect on supplier RSI.

We note three potential channels whereby suppliers may react to downward movements in customer stock price, illustrated in Figure 1. First, suppliers may perceive that the market is signaling negative information about the customer when a customer's stock price declines. Similar to the intuition modeled in Titman (1984), suppliers worry that the value of their RSI will decrease if the economic prospects of the customer decline. We therefore propose a direct channel where suppliers observe perceived changes in customer growth prospects and adjust investment in response. Additionally, market signals are more important when there is less certainty about customer fundamentals, i.e., about future customer demand. We therefore expect a stronger effect when the customer has higher sales volatility.

Second, customers may adjust their *own* investment in response to changing stock prices. Chen, Goldstein, and Jiang (2007) note that stock prices are a source of information that can guide the firm's own investment decisions. If a customer uses information in its own stock price to make investment decisions, it may reduce investment when its stock price declines. The supplier then reduces its RSI in response to the decrease in the customer's investment level. We expect both the customer and its suppliers to be more sensitive to the customer's stock price when there is relatively more information in the customer's stock price.

Finally, when the customer's stock price declines, the customer may be relatively more vulnerable to takeover threats (Dong, Hirshleifer, Richardson, and Teoh (2006), Edmans, Goldstein, and Jiang (2012)). This possibility worries suppliers, as RSI loses value outside of their current relationships. A

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empirical tests. Rather, they generate cross-sectional predictions from the model and examine whether the observed correlations are consistent with their predictions.

takeover may result in changes in the customer's future financial and business policies. Further, a vertical takeover by a rival of the supplier or a horizontal takeover by a rival of the customer may have negative business implications for the supplier, such as foreclosure (Eckbo (1983), Fee and Thomas (2004), Shahrur (2005), and Shenoy (2012)). The supplier therefore reduces its RSI in response to changes in the perceived takeover threat to its customer. We expect the effect to be stronger when the customer firm has relatively fewer anti-takeover defenses.

We test the above hypotheses using a sample of Compustat suppliers and customers from 1981 to 2007. We follow Edmans, Goldstein, and Jiang (2012) and use mutual fund flow-driven price pressure to identify exogenous variation in stock price. Mutual fund fire sales due to large outflows are not related to firm fundamentals, and thus cause stocks to be temporarily undervalued (Coval and Stafford, 2007). For each firm-year we focus on the stock valuation of the supplier's most important customer. Our primary empirical setup is a 2SLS estimation where we first estimate the exogenous effect of mutual fund-driven price shocks on the customer's Tobin's *Q*, and then the effect of instrumented customer's Tobin's *Q* on the supplier's RSI. As discussed earlier, this methodology allows us to identify exogenous variation in customer stock prices and satisfy the exclusion restriction for our 2SLS tests.

Consistent with our first hypothesis, we find that valuation decreases for a firm's biggest customer reduce the firm's future RSI. An exogenous one standard deviation decrease in the market value of the customer in terms of Tobin's *Q* is related to a 0.42 standard deviation reduction in the supplier's R&D intensity in the following year. The effect is confined to supplier-customer pairs where the customer has higher sales volatility; these are likely to represent situations where the supplier is less certain about the customer's future economic prospects. Consistent with our second hypothesis, we also find a relation between stock price-driven changes in the customer's *own* investment levels and the supplier investment levels. We first examine the effect of an exogenous price change on the customer's own investment levels. We find that customers do indeed appear to cut their own investment in response to decreases in their own stock price. We then find that suppliers cut RSI in response to decreases in the customer's investment levels. We also find that the link between customer value and supplier RSI is enhanced for customers who have relatively more information in their stock prices, consistent with the hypothesis that suppliers and customers react to information in customer stock prices. Lastly, we find that the probability of a takeover is higher when the customer experiences negative shocks to the stock price, consistent from the literature (Edmans, Goldstein, and Jiang (2012)). Additionally, the supplier reduces RSI when the instrumented probability of a customer takeover is higher. This effect is larger if the customer firms have relatively fewer anti-takeover defenses in their corporate charters or state laws.

We believe that our study makes a contribution to two large areas of the extant finance literature. First, we contribute to the broad literature examining links between supplier (customer) RSI and customer (supplier) policies. Specifically, we examine exogenous changes in the customer's market value and the supplier's response.[2] In addition to examining linkages between supplier investment and customer stock prices, we contribute to the empirical literature by identifying exogenous variation in customer characteristics. Second, we contribute to the literature on the real effects of financial markets.[3] Extant literature shows that managers learn information from their own stock prices (Chen, Goldstein, and Jiang (2007)) as well as their rivals (Foucault and Fresard (2013)). Our study extends this question and examines the influence of stock market feedback on stakeholders with strong economic ties such as major suppliers and customers. Our findings suggest that the real effects of the stock market are further-reaching than currently documented in the literature. The observation that suppliers appear to "learn" from the stock prices of their customers also highlights an important channel through which a financial market disruption such as mutual fund fire sales can create further negative externalities to the affected firms. This finding also implies the role of stock market feedback in bridging the information gap in supply chains (Dass, Kini, Nanda, Onal, and Wang (2013)).

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[2] For example, see Haugen and Senbet (1978, 1988), Titman (1984), Maksimovic and Titman (1991), Allen and Philips (2000), Mackay and Philips (2005), Fee, Hadlock, and Thomas (2006), Kale and Shahrur (2007), Raman and Shahrur (2008), Costello (2013), Dass, Kale, and Nanda (2013), Kale, Kedia, and Williams (2013))

[3] For example, see Gilchrist, Himmelberg, and Huberman (2005), Dong, Hirshleifer, Richardson, and Teoh (2006), Baker, Ruback, and Wurgler (2007), Chen, Goldstein, and Jiang (2007), Foucault and Gehrig (2008), Baker (2009), Polk and Sapienza (2009), Edmans, Goldstein, and Jiang (2012), Foucault and Fresard (2012, 2013), Hau and Lai (2013). See Bond, Edmans, and Goldstein (2012) for a survey.

We proceed as follows. We describe our sample, key variables, and our key instrumental variable in Section 1. In Section 2 we discuss our multivariate tests and in Section 3 we provide additional robustness tests. Section 4 concludes.

1. Data and Sample Description

We begin with all U.S. public firms with accounting data in Compustat from 1981 to 2007. We exclude financial firms (SIC 6000-6999) and utility firms (SIC 4900-4999) from the sample. We next use the Compustat Segment database to find the reported customers of these firms. SFAS 14 and SFAS 131 require public companies to report customers that account for more than 10% of their annual sales. In the Compustat Segment files, the name and sales of these customers are reported. We extract the accounting information of customers by matching their names to the corresponding GVKEY in Compustat following the literature (e.g., Fee and Thomas, 2004; Kale and Shahrur, 2007). We define the most important customer (excluding financial and utility firms) for each supplier-year as the customer that accounts for the highest fraction of the supplier's sales over the previous three years. Our final sample consists of 14,993 firm-year observations that have identified principal customers from 1981 to 2007.

1.1. Proxy for Relationship-specific Investment and Firm Characteristics

We use *Supplier R&D*, defined as the ratio of R&D expenditure to lagged assets, as our main proxy for supplier RSI and our primary dependent variable in our second stage estimates. We define *Supplier R&D* as zero if no R&D is reported by the supplier. R&D intensity is often used as a proxy for RSI in empirical literature on transactions cost economics (e.g. Boerner and Macher (2001)). Armour and Teece (1980) claim that R&D-intensive supply chains are likely to have complex interstage interdependencies that lead to higher RSI. Allen and Philips (2000) suggest that research-intensive industries are more likely to create RSI. For robustness, we also define RSI using data on patent citations. Citations of patents indicate that the technology from an existing patent is used in a new patent. The presence of patent cross-citations between firms and their customers is, therefore, an indication of knowledge flow between the two firms (Jaffe, Tratjtenberg, and Fogarty (2000)). If suppliers and customer cite each other's patents, it is more likely that their investments are relationship-specific.

We obtain patent citation data from NBER 2006 updated patent citation database. The data file of interest is the patent citation file, *cite76_06*, which includes patent numbers of the citing patent and the cited patent. We trace each patent number (for both citing and cited patents) to NBER's unique patent assignee identifier, *PDPASS* using the patent assignee file, *patassg.* Next, we use the files *dynass* and *pdpcohdr* to map the patent identifier to Compustat and merge this citing/cited data to the firms and customers in our sample from Compustat Segment Tapes. We then create an indicator variable, *Cross Citation,* which is equal to one if the supplier firm cites one of the customer's patents in the subsequent three years.

As we examine the relation between the customer's stock price and the supplier's RSI decision, we use customer Tobin's *Q* as the main dependent (independent) variable in the first (second) stage. Tobin's *Q* is defined as the sum of total assets and the difference between market value and book value of total common equity, divided by total assets. We also control for a number of supplier and customer characteristics that are likely to affect supplier RSI. Specifically, for both supplier and customer firms we include their firm size, leverage, ROA, sales growth, sales volatility, and industry concentration in our estimates. Our industry concentration measures include traditional Compustat Herfindahl indexes as well as Fitted Herfindahl (Hoberg and Phillips (2010a)), the FIC Herfindahl (Hoberg and Phillips (2010b,c)), and the TNIC Herfindahl (Hoberg and Phillips (2010b,c)). We also include supplier Tobin's *Q* to control for any valuation effects common to the entire supply chain. We also use other variables in analyses examining the role of stock price informativeness, financial constraints, and takeover threats. We define these variables in their corresponding tests later in the paper.

For robustness, we also examine the impact of supplier stock price on the RSI of all the reported customers. For this test, we compute the average of the above characteristics across all the reported customers weighted by the fraction of sales to each customer (see Kale and Shahrur (2007)). A detailed description of these variables is presented in the appendix.

1.2. Instrumental Variable for Stock Prices

We use liquidity-driven mutual fund price pressure as an instrument for customer's stock price following Edmans, Goldstein, and Jiang (2012).[4] Liquidity trades made by mutual funds that experience significant outflows can cause price changes unrelated to the fundamentals of the firm or its suppliers. We compute this variable using mutual fund return data from CRSP and mutual fund holding data from Thomson Reuters. First, we compute mutual fund flow as:

$$Outflow_{j,t} = -\frac{F_{j,t}}{TA_{j,t-1}},$$

where $F_{j,t}$ is the inflow of fund *j* in quarter *t*, and $TA_{j,t-1}$ represents the total assets of fund *j* at the beginning of the quarter. We retain funds with *Outflow* below -5% to focus on funds that are suffering liquidity shocks. To additionally mitigate the concern that mutual fund flow may reflect the fundamentals of stocks the funds hold, we also remove funds that specialize in one industry. For funds that are identified as undergoing large outflow, we compute the funds' holding of each stock as:

$$s_{i,j,t} = \frac{SHARES_{i,j,t} \times PRC_{i,t}}{TA_{j,t}},$$

where $SHARES_{i,j,t}$ is the number of shares of stock *i* held by fund *j* in quarter *t*, and $PRC_{i,t}$ is the price of stock *i* in quarter *t*. Finally, we measure the mutual fund price pressure as:

$$s_{i,j,t} = \sum_{j=1}^{m} \frac{F_{j,t} \times s_{i,j,t-1}}{VOL_{i,t}},$$

where $VOL_{i,t}$ is the dollar trading volume of stock *i* in quarter *t* and the pressured is only summed over funds that are identified as having extreme outflow. Note that this measure is not based on the actual trades of mutual funds but rather their holdings prior to the outflow. This measure is immune from the possibility that mutual funds trade these stocks deliberately even when they are under significant outflow. As Edmans, Goldstein, and Jiang (2012) show, stocks that experience significant price pressure (as indicated by this measure) experience a temporary decline in the stock price that is eventually recovered

[4] We thank Edmans et al. for making their measure available: http://faculty.london.edu/aedmans/research.html

in two years on average. This suggests that price changes driven by mutual fund liquidity-driven price pressure are exogenous to the fundamentals of the firms.

1.3. Summary Statistics

We present summary statistics in Table 1 for all variables. We note that the average size of customer firms in terms of total assets is 14.6 billion dollars while that of the supplier firms is 89.7 million dollars. This is common to the Compustat supplier-customer data, as large customers tend to account for a significant portion of sales to relatively smaller customers. The average value of *Customer MFFlow* is -0.610, suggesting that on average, the expected trade induced by mutual fund fire sales may account for as much as 0.61% of the quarterly trading volume. There is also a significant variation in the value of *Customer MFFlow* (with a standard error of 0.793). This ensures sufficient exogenous variation in the customers' stock prices. The summary statistics for other control variables are comparable with the extant literature. All variables are defined in the appendix and are winsorized at the 1% and 99% levels.

2. Multivariate tests

In this section, we investigate the effect of an exogenous decrease in customer's stock price on supplier's RSI. We use 2SLS as our primary methodology throughout the paper. Specifically, our main first stage model is:

$$Cust.Q_t = \beta_1\, Cust.MFFlow_t + \sum_{i=2}^{n} \beta_i\ Controls_t + Constant + v,$$

where *Customer MFFlow* is our instrument capturing the exogenous, flow-driven price pressure on the customer firm's market valuation, *Customer Q*. Our primary second stage is then:

$$Supplier\ R\&D_{t+1} = \beta_1\, \widehat{Customer}\ Q_t + \sum_{i=2}^{n} \beta_i\ Controls_t + Constant + u,$$

where *Supplier R&D* represents next year's RSI by the supplier, and $\widehat{Customer}\ Q_t$ is the customer's instrumented market value.

A key assumption is that our instrument, *Customer MFFlow*, satisfies the exclusion restriction. Given the evidence in Edmans, Goldstein, and Jiang (2012), we believe that our instrument captures exogenous, non-fundamental price changes in the customer's stock and affects supplier decisions solely through the effect on customer value. One potential objection might be that mutual fund outflows signal some fundamental changes to the customer industry's growth prospects. Therefore, our measure would not be capturing the supplier's response to exogenous price changes in the customer's stock, but rather some broader industry information. However, *Customer MFFlow* captures price pressure driven by liquidity trades generated by fund outflows, not aggregate fund flows themselves. A follow-up objection may be that individual investors are withdrawing money from specific mutual funds due to broader industry information possessed by individual investors that mutual funds do not have. However, as mentioned above, we remove funds that specialize in specific industries in an attempt to address this concern.

Additionally, one may worry about reverse causality. For example, a customer's stock price may decline if the market anticipates future reductions in RSI by the supplier. However, our measure captures price changes unrelated to the fundamentals of the customer. Further, Edman, Goldstein, and Jiang (2012) show that the effect is temporary (prices recover after approximately two years on average) and that the effect is consistent with a price pressure hypothesis. It is therefore unlikely that the price changes on which we focus are related to fundamentals, and they are certainly unrelated to the market's inference about future investment by a firm's suppliers.[5] In general, we believe that our instrument satisfies the exclusion restriction. Finally, in each table, we report all first-stage regressions along with each corresponding Kleibergen-Paap rk Wald F-statistic to assess the strength of our instrument. Throughout the paper, we document a strong relation between *Customer Q* and *Customer MFFlow*.[6]

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[5] To this point, Cohen and Frazzini (2008) find that a firm's stock price does not immediately incorporate information about product market participants, such as suppliers and customers.

[6] This is the equivalent of the Cragg-Donald Wald F-statistic when using clustered standard errors. A common "rule of thumb" is that a Cragg-Donald Wald F-statistic greater than 10 indicates a strong instrument (Stock, Wright, and Yogo (2002)). However, to our knowledge, no standard critical values of the Kleinbergen-Paap rk Wald F-statistic exist, primarily because the critical value depends on the specific i.i.d. violation that the clustered standard errors are

Our multivariate tests follow. All standard errors in our subsequent multivariate tests are clustered at the firm level, and all models include year fixed effects and either industry or firm fixed effects.

2.1. Customer stock prices and supplier RSI

In Table 2, we explore the effect of customer mispricing on *Supplier R&D*. Models 1-3 contain reduced-form OLS results where we regress *Supplier R&D* on *Customer Q*, *Customer MFFlow*, and both variables, respectively. *Customer MFFlow* is significantly positively related to *Supplier R&D* in both Models 2 and 3. The coefficient on *Customer Q* is significantly positive in Model 1, but appears to be dominated by the effect of *Customer MFFlow* when both variables are included in Model 3. Models 4-7 contain our 2SLS estimates. In our first-stage estimates, models 4 and 6, we see that *Customer MFFlow* is strongly positively related to *Customer Q*, with a t-statistic between 6.95 and 8.11. Further, the Kleibergen-Paap rk Wald F-statistic ranges from 48.29 to 65.74, indicating that our results are unlikely to suffer from a weak instrument. In the second stage estimates, Models 5 and 7, we find that an exogenous decrease in *Customer Q* is strongly associated with lower *Supplier R&D*. The coefficients are significant at the 1% level and indicate that a one-standard-deviation reduction in the exogenous change in *Customer Q* is related to a 0.42 standard deviations decline in *Supplier R&D*.

The results in Table 2 suggest that an exogenous decrease in the customer's stock price due to mutual fund fire sales causes the supplier to cut R&D, which presumably reflects the cut in RSI. Although R&D is a common proxy for RSI (e.g., Boerner and Macher (2001)), we note that R&D is an inherently noisy proxy for RSI as it also includes investment not related to its customer. To further show that the decrease in R&D is indeed relationship specific, we examine whether the supplier is less likely to have an innovation output related to the customer based on citation after the decrease in the customer's stock price. In Table 3, we repeat our earlier test, this time using a 2SLS probit model and *Cross Citation* as

meant to address (Stock and Yogo (2005)). Nonetheless, all first-stage estimates have Cragg-Donald Wald F-statistics greater than 10 and are available from the authors upon request.

the second-stage dependent variable.[7] *Cross Citation* is a binary variable that equals 1 if the supplier produces any patent that cites one of the customer's patents in the following three years, and 0 otherwise. We present results controlling for customer characteristics, for both supplier and customer characteristics, and for both supplier and customer characteristics along with previous cross-citation activity. In our first-stage estimates (models 1, 3, and 5), we continue to find that *Customer MFFlow* is a strong instrument for *Customer Q*. In the second stage, we find that exogenous decreases in *Customer Q* are strongly related to lower probabilities of cross-citation by suppliers.

The above results suggest that exogenous changes in customer valuation affect supplier RSI. For robustness and to assuage additional concerns surrounding the exclusion restriction, we perform a subsample test in Table 4. In this test, we allow *Customer Q* to vary across customers with high sales volatility and low sales volatility, similar to the interaction setup in Giroud and Mueller (2011). The upshot is that suppliers should react more strongly to customer stock prices in situations in which suppliers have more uncertainty about their customers (Titman (1984), Kale and Shahrur (2007)). We use customer sales volatility as our proxy for the customer uncertainty, as volatile customer sales indicate volatile downstream demand for suppliers. Table 4 contains second-stage estimates of *Customer Q* interacted with both high and low *Customer Sales Volatility*, where "high" and "low" volatility buckets are defined using the sample median of the previous three-year sales volatility. Our instruments for this test are *Customer MFFlow* x *High Customer Sales Volatility* and *Customer MFFlow* x *Low Customer Sales Volatility*. The results in both models suggest that *Customer Q* significantly affects *Supplier R&D* only among high-volatility customers. For high-volatility customers, *Customer Q* has a coefficient ranging from 0.076 to 0.094, and is always significant at the 1% level. For low-volatility customers, the coefficient is insignificant and ranges from 0.004 to 0.035. The Kleibergen-Paap rk Wald F-statistics continue to indicate that our results do not suffer from weak instruments.

In sum, tables 2-4 demonstrate that an exogenous decrease in *Customer Q*, instrumented by downward price pressure created by mutual fund outflows, is related to a decrease in subsequent supplier

[7] Note that we calculate the F-statistics using a linear 2SLS model.

RSI. Further, the effect is limited to cases where there is greater uncertainty about customer demand. These results are consistent with our hypothesis that suppliers react to exogenous downward changes in the customer's stock price by adjusting RSI.

2.2. Customer stock price, customer investment, and supplier RSI

Above, we explore whether suppliers adjust RSI directly in response to changes in customer stock price. In the next section, we explore whether there is also an effect on the customer's *own* investment levels, which are then mirrored by the supplier's RSI. In Panel A of Table 5, we estimate the effect of *Customer Q* on the customer's own investment, *Customer* $R\&D_{t+1}$ and *Customer* $CAPEX_{t+1}$. We continue to use *Customer MFFlow* as our first-stage instrument for *Customer Q*. We find that a one-standard-deviation decrease in *Customer Q* is associated with a decrease in *Customer* $R\&D_{t+1}$ and *Customer* $CAPEX_{t+1}$ of 1.55 standard deviations and 1.15 standard deviations, respectively. Thus, consistent with Chen, Goldstein, and Jiang (2007), we indeed find that customers adjust their own investment levels in response to stock price changes.

Having demonstrated a relation between exogenous stock price changes and the customer's own investment levels, we next explore the relation between instrumented customer investment and supplier RSI. In Panel B of Table 5, we use *Customer MFFlow* in our first-stage regressions, this time as an instrument for *Customer* $R\&D_{t+1}$ and *Customer* $CAPEX_{t+1}$. Our goal is to capture the exogenous variation in customer investment due to the exogenous decrease in the stock price. We find that *Instrumented Customer R&D* significantly predicts *Supplier R&D* at the 1% level. A one-standard-deviation decrease in *Instrumented Customer R&D* corresponds to a decrease in *Supplier R&D* of 0.17 standard deviations. We do not find a statistically significant relation between *Customer CAPEX* and *Supplier R&D*.

One concern is that our tests are merely picking up a simple correlation between supplier and customer investment levels. To eliminate this possibility, we re-estimate our model in Table 6, except we split instrumented *Customer Q* on high/low $1\text{-}R^2$ (Roll (1988)). The intuition is that firms with low R^2 are likely to have higher levels of stock price informativeness. These firms are relatively more likely to make investment decisions based on their stock prices (Chen, Goldstein, and Jiang (2007)). We claim that our tests in Table 5 are capturing a channel where the customer reduces investment in response to a negative stock market signal, and subsequently affects the supplier's RSI. We therefore expect exogenous declines in the customer stock price to be associated with greater decreases in supplier RSI when the customer's stock price is more informative. However, since mutual fund fire sales affect both the stock price and its informativeness, we interact *Customer Q* with $1\text{-}R^2$ measured in year *t*-1. The intuition is that customers and suppliers are more sensitive to an exogenous decrease in customer's stock price if the price has been informative *prior to* mutual fund fire sales. Our results in Table 6 are consistent with this intuition. We indeed find that for the high stock price informativeness group, the coefficient on *Customer Q* is between 0.062 and 0.087 and statistically significant at the 1% level. For the low price informativeness group, the coefficient on *Customer Q* is between 0.009 and 0.028 and statistically insignificant.

An additional potential concern is that our cross sectional analysis using $1\text{-}R^2$ may instead be capturing some type of fundamental uncertainty about the customer (Morck, Yeung, and Yu (2013)). In Table 7, we use another empirical proxy for stock price informativeness and cut based on high and low probability of informed trading, or *Customer PIN* (Duarte and Young (2009)). We find that *Customer Q* affects *Supplier R&D* only in the sample where the probability of informed trading is high, though the statistical power of the instrument becomes weaker with the interaction. This finding leads to a similar intuition as that in Table 6.

Our results in tables 5, 6, and 7 are broadly consistent with the notion that customers adjust their own investment in response to exogenous stock price changes. This policy change by the customer influences supplier behavior. Our subsample analysis using $1\text{-}R^2$ also suggests that this effect reflects learning by both suppliers and customers.[8] Specifically, they are learning from stock market feedback that depends on the informativeness of the customer's stock price.[9]

[8] Note that in our specific setting, the supplier's and customer's inference is incorrect because the downward movement in the customer's stock price is unrelated to fundamentals.

[9] We also consider the possibility that a decline in the customer's stock price affects investment via financial constraints. A reasonable hypothesis is that the exogenous price decline affects either the customer firm's cost of capital and/or access to external financing. We test this hypothesis using two measures of financial constraints, the

2.3. Customer stock price and corporate takeover risk

Our final set of main tests deal with the hypothesized third channel, the supplier's concern that a customer experiencing decreases in its stock price may be at risk of a takeover threat. We define *Customer Takeover* as a takeover attempt for majority ownership in year t+1. In Table 8, Panel A, we use a 2SLS probit model with an identical first-stage regression as in sections 2.1 and 2.2, but the second stage is a probit model which estimates: [10]

$$p(Customer\ Takeover_{t+1}) = \beta_1 \widehat{Cust.Q}_t + \sum_{i=2}^{n} \beta_i\ Controls_t + Constant + u.$$

Instrumented *Customer Q* is significant at the 1% level and implies that a one-standard-deviation decrease in *Customer Q* raises the probability of a customer takeover attempt from 2.8% to 27.2%. Thus, we do find evidence that random, exogenous declines in customer value increase the probability of takeover attempts, similar to evidence in Edmans, Goldstein, and Jiang (2012).

Next, we explore the relation between customer takeover probability and supplier RSI in Panel B. Our first stage model is:

$$p(Customer\ Takeover_{t+1}) = \beta_1\ Cust.MFFlow_t + \sum_{i=2}^{n} \beta_i\ Controls_t + Constant + v,$$

where we estimate the probability of a customer takeover using our primary instrument, *Customer MFFlow*. We then examine the effect of the estimated customer takeover probability on subsequent supplier RSI in the second stage:

$$Supplier\ R\&D_{t+1} = \beta_1\ Cust.\widehat{Takeover}_{t+1} + \sum_{i=2}^{n} \beta_i\ Controls_t + Constant + u.$$

Here *Controls* also include *Customer R&D* and *Customer CAPEX*, as they are also potential channels through which customer's stock price can impact supplier's RSI. Note that we manually correct the standard errors in this test by bootstrapping 50 times, as we must manually estimate both stages due to the first-stage probit model. We find that an increase of 10 percentage points in the instrumented *Customer*

WW Index (Whited and Wu, 2006) and an index based on size and age, the *SA Index* (Hadlock and Pierce, 2010). We are unable to find consistent evidence for a financing channel.

[10] Note that we calculate the F-statistics using a linear 2SLS model.

Takeover probability is associated with a 5% decrease in *Supplier R&D*. Therefore our results suggest that suppliers react to the increased probability of customer takeovers resulting from declines in stock prices. This increased probability reduces the *ex-ante* expected value of RSI and suppliers appear to reduce investment as a result.

We estimate another subsample analysis in Table 9 to provide additional support for our takeover hypothesis. We use the Gompers, Ishii, and Metrick (2003) index of anti-takeover defenses, the *GIndex* to split the coefficient of *Customer Q*. The *GIndex* is created by summing the number of a firm's anti-takeover defenses in its corporate charter or state law. We define firms with a *GIndex* greater than 10 to have relatively high levels of takeover defenses and firms with a *GIndex* less than 10 to have relatively low takeover defenses. If our hypothesis relating supplier RSI to customer takeover risk is valid, we expect suppliers to react more strongly when the customer firm has lower levels of takeover defenses. Our first-stage instruments for *Customer Q × GIndex <= 10* and *Customer Q × GIndex > 10* are *MFFlow × GIndex <= 10* and *MFFlow × GIndex > 10*, respectively. In both models 1 and 2, we find that *Customer Q* is significantly positive with coefficients between 0.044 and 0.064 for the firms with *GIndex <= 10*. These results imply that *Supplier R&D* decreases by 0.42 standard deviations for a change of one standard deviation in *Customer Q*. Conversely, the coefficients on *Customer Q* for high *GIndex* firms range from -0.004 to -0.012 and are statistically insignificant.

The evidence in tables 8 and 9 provide support for the assertion that suppliers with relationship-specific investments worry about the takeover risk of their customers. Consistent with Edmans, Goldstein, and Jiang (2012), we find that the customer's takeover probability increases with exogenous declines in customer market value. We further show that suppliers reduce RSI in response to the takeover threat. Finally, we show that the link between customer value and supplier RSI is limited only to those customers with relatively fewer anti-takeover provisions, further supporting our hypothesized takeover channel. These results suggest that the takeover likelihood of the customer is part of the information supplier may learn from customer's stock price.

In Section 2, we provide evidence suggesting three channels whereby exogenous changes in the customer's stock price affects relation-specific investments by the supplier. Specifically, we find evidence of a direct link between customer stock prices and supplier RSI, a link between exogenous changes in customer investment and supplier RSI, and a link between the customer's takeover risk and supplier RSI. In the following section, we present several robustness tests, including alternative industry definitions, the inclusion of firm fixed-effects, and alternative customer definitions. We also explore the effect of supplier shocks on customer investment.

3. Robustness

3.1. Firm fixed effects and alternative industry definitions.

We present a host of robustness tests in Table 10. Specifically, we note that industry definitions and Herfindahl index definitions are important variables in product market research. Further, a host of recent papers show how different definitions for these variables may lead to faulty inference (e.g., Ali, Klasa, Yeung (2009), Hoberg and Phillips, (2010A), (2010B)). Thus, we re-estimate our primary model from Table 2, but in models 2-9 we replace the 4-digit SIC *Herfindahl* with a 3-digit SIC *Herfindahl (HHI(SIC3)),* a fitted 3-digit SIC *Herfindahl (Fitted HHI(SIC3)), FIC HHI,* and *TNIC HHI*. Additionally, we include firm fixed-effects in models 1, 3, 5, 7, and 9. We report only the second-stage results in Table 10.

New industry definitions and/or the inclusion of firm fixed effects do not significantly affect our results. We continue to find a statistically significant relation between exogenous decreases in customer stock price and declines in supplier RSI across all models. Further, the economic effect does not vary greatly; the coefficient on instrumented *Customer Q* ranges from 0.030 to 0.046 for the models with industry fixed effects and from 0.023 to 0.036 for the firm fixed-effects models. Thus, the primary inference of the paper appears unaffected by the inclusion of firm fixed-effects and alternative industry definitions.

3.2. Customer portfolio investment and supplier stock price

In our final set of tests, we invert our dataset and consider the effect of the supplier's stock price on customer RSI. Our expectation is that customers should react to supplier stock price declines in the same way that suppliers respond to decreases in customer stock prices. We first mention a caveat: the construction of the supplier-customer data in Compustat makes this test somewhat less intuitive than our earlier results. For example, as discussed in Section 2, the average supplier in our dataset is smaller than our average customer. This assists our earlier examination of customer stock prices and supplier RSI, because we are conditioning on cases where the customer is very important to the supplier. However in the inverted data, it is less likely that the supplier is as important to the customer. To partially offset this issue, we construct portfolios of customer characteristics by using a sales-weighted average of *all* reported customers as in Kale and Shahrur (2007), which has the effect of controlling for the relative importance of each customer. Our resulting database contains supplier characteristics and the sales-weighted average R&D of the aggregate customer portfolio.

In Table 11, we present 2SLS estimates with a first stage of:

$$Supplier\ Q_t = \beta_1\ Supplier\ MFFlow_t + \sum_{i=2}^{n} \beta_i\ \ Controls_t + Constant + \ v,$$

and a second stage of:

$$Customer\ Portfolio\ R\&D_{t+1} = \beta_1\ \widehat{Supplier}\ Q_t + \sum_{i=2}^{n} \beta_i\ \ Controls_t + Constant + \ u.$$

In our first estimate (models 1 and 2), we find a statistically significant relation between instrumented *Supplier Q* and *Customer Portfolio R&D*. The results imply that a one-standard-deviation change in supplier value results in a corresponding decline of 0.22 standard deviations in the customer portfolio's R&D. The coefficient on *Supplier Q* in the second estimate (models 3 and 4) is almost identical to the first, but is not significant at conventional levels with a p-value of 0.17.

Thus, we find some supporting evidence that even stock price declines for smaller suppliers can affect RSI at the customer level. We believe that the results in Table 11 provide more supporting evidence demonstrating a real effect of stock prices on investment levels in the supply chain.

4. Conclusions

We provide evidence that exogenous changes in stock prices affect real investment in the supply chain. We identify exogenous stock price declines using the Edmans, Goldstein, and Jiang (2012) measure of *MFFlow*. This measure identifies stocks that experience downward price pressure due to mutual fund outflows and excludes declines related to fundamentals and/or information. We then proceed to explore channels through which exogenous changes in customer valuation may affect relationship-specific investment levels by supplier firms, using a 2SLS methodology with *MFFlow* as our instrument.

We identify at least three channels through which the customer's stock price may affect the supplier's RSI. First, we document that supplier RSI declines subsequent to an exogenous decline in customer stock price. This observation is consistent with the hypothesis that the supplier worries that the market is signaling worse future prospects for their customer, and the supplier consequently lowers its exposure by reducing investment specific to the customer firm. A subsample analysis indicates that this result is enhanced when there is more uncertainty about the customer, using customer sales volatility as a proxy. Second, we show that the customer also responds to changes in its stock price by reducing its own investment, causing the supplier to decrease investment. This effect is enhanced when there is more information in the customer's stock price. Third, we demonstrate that the decline in customer stock price affects the probability of the customer being a takeover target, as in Edmans, Goldstein, and Jiang (2012). Additionally, we document that the supplier reduces RSI in response to the higher takeover probability. Further, we find that the link between customer stock price and supplier RSI is enhanced when the customer firm has relatively fewer anti-takeover defenses. We also show that our results are robust to alternative industry definitions and including firm fixed-effects. We also find evidence that the channel also flows downstream, i.e. that customers adjust RSI in response to supplier stock price declines.

Our paper makes two contributions to the literature. First, we add to the growing literature on the relation between customer decisions/policies and supplier RSI (e.g., Haugen and Senbet (1978, 1988), Titman (1984), Maksimovic and Titman (1991), Mackay and Philips (2005) and Kale and Shahrur (2007), Raman and Shahrur (2008), Costello (2013), Dass, Kale, and Nanda (2013), Kale, Kedia, and Williams (2013)). However, we note that supplier RSI and most customer policies are optimal, equilibrium decisions which are jointly chosen by the supplier and customer *ex-ante*. Our additional contribution is that we identify an *exogenous* change in the customer's stock price and observe the supplier's subsequent reaction.

Secondly, we add to the literature examining the real effects of stock price changes (e.g., Gilchrist, Himmelberg, and Huberman (2005), Dong, Hirshleifer, Richardson, and Teoh (2006), Baker, Ruback, and Wurgler (2007), Chen, Goldstein, and Jiang (2007), Baker (2009), Polk and Sapienza (2009), Bond, Edmans, and Goldstein (2012), Edmans, Goldstein, and Jiang (2012), Hau and Lai (2013)). We contribute to this literature by showing that stock price changes affect product market participants other than the firm itself. Specifically, we show that stock price changes affect the investment decisions of suppliers and customers of the firm. Our findings suggest that the real effects of the stock market are further-reaching than currently documented in the literature. An improved information environment of the financial market may also help reduce supply chain friction.

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Appendix

MFFlow is mutual fund price pressure provided by Edmans, Goldstein, and Jiang (2012).

R&D is the ratio of the firm's R&D expenditure to lagged assets.

Ln(Assets) is the natural logarithm of total assets.

Leverage is the sum of long term debt and debt in current liabilities divided by total assets.

Q is the sum of total assets and the difference between market value and book value of total common equity, divided by total assets.

ROA is equal to earnings before extraordinary items to lagged asset ratio.

Sales Growth is the growth in sales divided by lagged sales.

Sales Volatility is the standard deviation of sales intensity (ratio of sales to assets) in the past three years.

Herfindahl is the Herfindahl index of industry defined by 4-digit SIC.

CAPEX is the capital expenditure divided by lagged net total value of property, plant and equipment.

WW Index is equal to -0.091 × Cash Flow/Assets - 0.062 × I(Cash Dividend Dummy>0) + 0.021 × Long Term Debt/Assets - 0.044 × Ln(Assets) + 0.102 × 3-digit SIC Industry Growth - 0.035 × Sales Growth.

SA Index is equal to -0.737 × Ln(Assets) + 0.043 × $(\text{Ln(Assets)})^2$ - 0.040 × Age where *Assets* is the total assets in billions of 2004 dollar and winsorized at $4.5 billion and *Age* is winsorized at 37 years.

Sales Fraction is the fraction of sales to the customer.

Figure 1

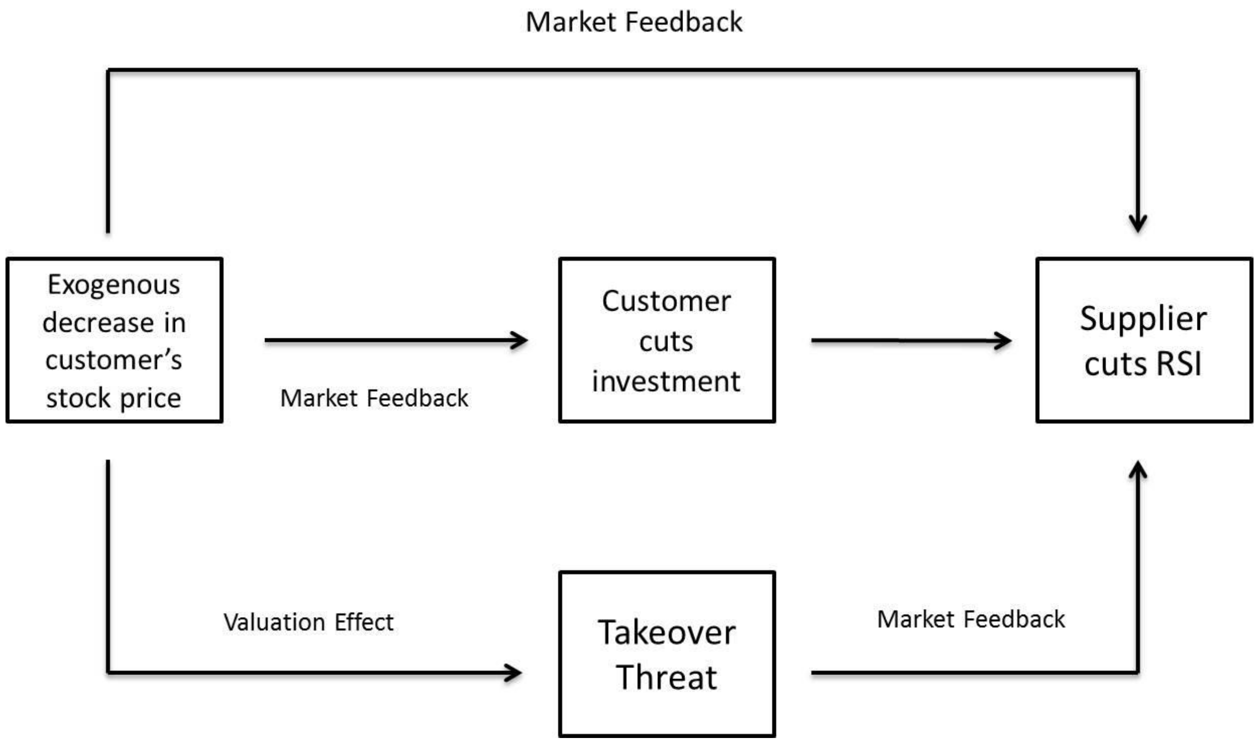
Market Feedback
Exogenous decrease in customer's stock price
Market Feedback
Customer cuts investment
Supplier cuts RSI
Valuation Effect
Takeover Threat
Market Feedback

Table 1
Summary Statistics

This table presents summary statistics of the main variables used in our analyses. We winsorize all variables at the 1st and 99th percentiles. All the variables are defined in the Appendix.

	N	Mean	Std. Dev.	25th	Median	75th
Supplier Characteristics						
Supplier R&D	13,053	0.067	0.119	0.000	0.010	0.090
Ln(Assets)	13,053	4.496	2.022	3.118	4.342	5.711
Leverage	13,053	0.234	0.238	0.033	0.187	0.359
ROA	13,053	-0.032	0.266	-0.071	0.033	0.090
Supplier Q	13,053	2.009	1.756	1.051	1.411	2.209
Sales Growth	13,053	0.194	0.510	-0.041	0.098	0.290
Sales Volatility	13,053	0.205	0.228	0.064	0.132	0.253
Herfindahl (4 digit-SIC)	13,053	0.211	0.157	0.094	0.165	0.274
Herfindahl (3 digit-SIC)	13,053	0.151	0.125	0.067	0.111	0.185
Fitted Herfindahl (3 digit-SIC)	11,128	0.059	0.024	0.045	0.052	0.065
Herfindahl (FIC)	4,958	0.209	0.173	0.096	0.160	0.252
Herfindahl (TNIC)	4,975	0.190	0.203	0.063	0.108	0.227
Customer Firm Characteristics						
Customer MFFlow	14,993	-0.610	0.793	-0.784	-0.365	-0.058
Customer Ln(Assets)	14,993	9.589	1.861	8.582	9.927	10.871
Customer Leverage	14,993	0.250	0.153	0.138	0.240	0.330
Customer ROA	14,993	0.059	0.073	0.025	0.057	0.092
Customer Q	14,993	1.768	1.124	1.070	1.380	1.974
Customer Sales Growth	14,993	0.090	0.168	0.009	0.071	0.143
Customer Sales Volatility	14,993	0.098	0.108	0.032	0.065	0.118
Customer Herfindahl (4 digit-SIC)	14,993	0.205	0.161	0.080	0.161	0.252
Customer Herfindahl (3 digit-SIC)	14,993	0.142	0.113	0.066	0.113	0.167
Customer Fitted Herfindahl (3 digit-SIC)	13,017	0.077	0.033	0.052	0.065	0.100
Customer Herfindahl (FIC)	5,337	0.257	0.217	0.122	0.191	0.274
Customer Herfindahl (TNIC)	5,639	0.145	0.157	0.051	0.092	0.175
Customer R&D	14,993	0.039	0.047	0.000	0.024	0.064
Customer CAPEX	14,642	0.256	0.149	0.160	0.227	0.310
Customer Takeover	14,992	0.028	0.165	0.000	0.000	0.000

(continued)

Table 1 (continued)

Customer Inst. Ownership	14,982	0.490	0.210	0.374	0.501	0.625
Customer Amihud	14,936	0.869	1.407	0.113	0.315	0.861
$1-R^2$	14,438	0.497	0.271	0.271	0.484	0.725
Customer PIN	10,411	0.114	0.040	0.089	0.109	0.132
Customer WWIndex	14,857	-0.473	0.096	-0.542	-0.496	-0.425
Customer SAIndex	14,993	-3.936	0.470	-4.278	-3.970	-3.690
Customer Gindex	7,899	8.518	2.673	6.000	9.000	11.000
Weighted Average Customer Firm Characteristics						
Customer R&D	17,378	0.037	0.047	0.000	0.020	0.063
Customer Ln(Assets)	17,378	9.208	2.067	8.166	9.582	10.616
Customer Leverage	17,378	0.243	0.145	0.133	0.229	0.325
Customer ROA	17,378	0.056	0.072	0.024	0.054	0.090
Customer Q	17,378	1.652	1.133	1.009	1.300	1.920
Customer Sales Growth	17,378	0.111	0.194	0.018	0.081	0.161
Customer Sales Volatility	17,378	0.104	0.111	0.035	0.070	0.126
Customer Herfindahl	17,378	0.205	0.148	0.094	0.167	0.259

Table 2

Customer stock price and supplier R&D

This table examines the relation between exogenous customer stock valuation due to mutual fund flow and the supplier's R&D levels. In Column 1 to 3 we present estimates from OLS regressions where the dependent variable is *Supplier R&D* in year t+1. In Column 4 to 7 we present estimates from 2SLS regressions. In the first stage, the dependent variable is *Customer Q* and the instrument is *Customer MFFlow*. In the second stage, the dependent variable is *Supplier R&D* in year t+1. For each firm-year we find the biggest customer based on reported sales from year t-3 to t-1. All variables are defined in the Appendix. Year and Fama-French 48 industry dummies are also included. t-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

	OLS			2SLS			
Stage:				1st	2nd	1st	2nd
Dependent Variable:		*Supplier R&D*		*Customer Q*	*Supplier R&D*	*Customer Q*	*Supplier R&D*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Customer MFFlow		0.004***	0.004***	0.095***		0.086***	
		(2.88)	(2.74)	(8.11)		(6.95)	
Customer Q	0.003*		0.002		0.069***		0.044***
	(1.87)		(1.39)		(4.10)		(2.72)
Customer Ln*(Assets)*	0.000	-0.001	-0.000	-0.066***	0.002	-0.065***	0.002*
	(0.01)	(-0.70)	(-0.50)	(-9.47)	(1.48)	(-8.57)	(1.95)
Customer Leverage	-0.017**	-0.021**	-0.019**	-0.919***	0.031*	-0.883***	0.018
	(-2.03)	(-2.50)	(-2.18)	(-10.98)	(1.66)	(-10.01)	(1.08)
Customer ROA	0.013	0.035*	0.019	6.978***	-0.458***	7.012***	-0.274**
	(0.74)	(1.81)	(0.99)	(26.35)	(-3.86)	(25.17)	(-2.40)
Customer Sales Growth	-0.008	-0.003	-0.005	0.578***	-0.038***	0.590***	-0.029**
	(-1.30)	(-0.54)	(-0.75)	(7.51)	(-2.96)	(7.25)	(-2.45)
Customer Sales Volatility	-0.031***	-0.035***	-0.034***	-0.610***	-0.008	-0.642***	-0.007
	(-3.50)	(-3.80)	(-3.65)	(-6.99)	(-0.56)	(-6.97)	(-0.53)
Customer Herfindahl	-0.031***	-0.027***	-0.027***	-0.173**	-0.022**	-0.180**	-0.019**
	(-4.14)	(-3.57)	(-3.53)	(-2.28)	(-2.08)	(-2.21)	(-2.18)
Ln*(Assets)*	-0.002***	-0.002***	-0.002***			0.011*	-0.002***
	(-2.73)	(-2.66)	(-2.69)			(1.70)	(-3.03)
Leverage	-0.052***	-0.051***	-0.051***			-0.090*	-0.047***
	(-7.90)	(-7.66)	(-7.63)			(-1.86)	(-6.36)
Supplier Q	0.015***	0.015***	0.015***			0.011	0.014***
	(11.63)	(11.25)	(11.21)			(1.45)	(10.62)
ROA	-0.100***	-0.100***	-0.099***			-0.250***	-0.089***
	(-13.43)	(-13.05)	(-13.01)			(-5.30)	(-10.20)
Sales Growth	0.007***	0.007***	0.007***			0.035**	0.006**
	(2.88)	(2.91)	(2.88)			(1.96)	(2.17)

(continued)

Table 2 (continued)

Sales Volatility	-0.027***	-0.028***	-0.027***			-0.049	-0.025***
	(-4.67)	(-4.69)	(-4.67)			(-1.01)	(-3.98)
Herfindahl	-0.030***	-0.031***	-0.031***			-0.009	-0.030***
	(-3.70)	(-3.71)	(-3.71)			(-0.13)	(-3.50)
Constant	0.050***	0.059***	0.055***				
	(2.87)	(3.43)	(3.14)				
Adjusted r^2	0.448	0.447	0.447	0.372		0.377	
Kleibergen-Paap rk Wald F				65.74		48.29	
Observations	13,461	13,053	13,053	14,993	14,993	13,053	13,053
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3
Customer stock price and patent citation

This table presents estimates from 2SLS probit regressions to show that a firm is less likely to produce patents based on its customer's technology if the customer is adversely affected by stock price decreases. In the first stage, the dependent variable is *Customer Q* and the instrument is *Customer MFFlow*. In the second stage, the dependent variable is an binary variable *Cross Citation* that equal to 1 if any of the firm's patents applied in the next three years cites the customer's patent. In Column 5 and 6, we also control for a binary variable *Cross* $Citation_{t-3,t-1}$ that equal to 1 if any of the supplier's patents granted from year t-3 to year t-1 cites the customer's patent. For each firm-year we find the biggest customer based on reported sales from year t-3 to t-1. All the variables are defined in the Appendix. Year and Fama-French 48 industry dummies are also included. Cragg-Donald Wald F statistic is estimated based on linear 2SLS model. z-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

Stage:	1st	2nd	1st	2nd	1st	2nd
Dependent Variable:	*Customer Q*	*Cross Citation*	*Customer Q*	*Cross Citation*	*Customer Q*	*Cross Citation*
	(1)	(2)	(3)	(4)	(5)	(6)
Customer MFFlow	0.112***		0.091***		0.085***	
	(4.53)		(3.29)		(2.61)	
Customer Q		0.912***		0.964***		1.137***
		(5.59)		(5.30)		(8.01)
Customer Ln*(Assets)*	-0.067***	0.224***	-0.062***	0.200***	-0.067***	0.159***
	(-5.56)	(6.70)	(-4.85)	(5.29)	(-4.41)	(4.96)
Customer Leverage	-0.966***	0.051	-0.975***	0.191	-0.859***	0.369
	(-6.95)	(0.13)	(-6.76)	(0.43)	(-5.40)	(0.92)
Customer ROA	7.383***	-6.986***	7.326***	-7.041***	7.453***	-8.605***
	(18.98)	(-5.86)	(18.69)	(-5.16)	(16.13)	(-7.76)
Customer Sales Growth	0.525***	-0.573***	0.577***	-0.688***	0.392**	-0.487**
	(4.04)	(-3.70)	(4.19)	(-4.01)	(2.39)	(-2.36)
Customer Sales Volatility	-0.998***	0.701**	-0.955***	0.589*	-1.012***	0.966***
	(-6.71)	(2.49)	(-6.00)	(1.83)	(-5.60)	(3.50)
Customer Herfindahl	-0.303**	0.140	-0.258*	0.236	-0.330**	0.293
	(-2.26)	(0.59)	(-1.76)	(0.98)	(-2.08)	(1.11)
Ln*(Assets)*			0.009	0.145***	0.012	0.070*
			(0.75)	(3.04)	(0.84)	(1.94)
Leverage			-0.182	-0.040	-0.129	-0.090
			(-1.56)	(-0.24)	(-0.81)	(-0.42)
Supplier Q			0.015	0.016	0.028*	-0.020
			(1.20)	(0.92)	(1.92)	(-1.02)
ROA			-0.381***	0.216	-0.359***	0.302*
			(-4.68)	(1.42)	(-3.58)	(1.91)

(continued)

Table 3 (continued)

Sales Growth			0.029	0.027	-0.039	0.138**
			(0.91)	(0.60)	(-1.01)	(2.37)
Sales Volatility			-0.032	0.191	0.008	0.018
			(-0.34)	(1.33)	(0.06)	(0.09)
Herfindahl			-0.047	-0.284	-0.020	-0.234
			(-0.40)	(-1.10)	(-0.14)	(-0.85)
Cross Citation$_{t-3,t-1}$					0.054	0.506**
					(1.08)	(2.40)
Constant	1.435***	-2.974***	1.276***	-3.374***	1.261***	-2.665***
	(9.42)	(-8.06)	(7.18)	(-6.64)	(7.48)	(-6.99)
Kleibergen-Paap rk Wald F	20.00		11.29		6.64	
Observations	4,812	4,812	4,231	4,231	2,930	2,930
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes

Table 4
Customer stock price and supplier R&D - high and low volatility

This table examines the impact of an exogenous change in the customer's stock valuation on supplier R&D, with the customer valuation allowed to vary across different levels of sales volatility. We present the second stage of 2SLS estimates. In the first stage, the dependent variables are interaction terms between *Customer Q* and binary variables indicating firms with above/below the sample median of *Customer Sales Volatility*. The instruments are interaction terms between *Customer MFFlow* and binary variables indicating firms with above/below the sample median of *Customer Sales Volatility*. In the second stage, the dependent variables is *Supplier R&D* in year t+1. For each firm-year we find the biggest customer based on reported sales from year t-3 to t-1. All the variables are defined in the Appendix. Year and Fama-French 48 industry dummies are also included. t-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

	(1)	(2)
Customer Q × High Customer Sales Volatility	0.094***	0.076***
	(4.16)	(3.34)
Customer Q × Low Customer Sales Volatility	0.035	0.004
	(1.59)	(0.18)
High Customer Sales Volatility	-0.113**	-0.136**
	(-2.14)	(-2.51)
Customer Ln*(Assets)*	0.001	0.001
	(0.63)	(0.70)
Customer Leverage	0.023	0.013
	(1.27)	(0.75)
Customer ROA	-0.396***	-0.197
	(-3.33)	(-1.56)
Customer Sales Growth	-0.058***	-0.056***
	(-3.24)	(-3.14)
Ln*(Assets)*		-0.002**
		(-2.50)
Leverage		-0.052***
		(-6.48)
Supplier Q		0.014***
		(9.45)
ROA		-0.097***
		(-10.25)

(continued)

Table 4 (continued)

Sales Growth		0.004
		(1.41)
Sales Volatility		-0.027***
		(-4.01)
Herfindahl		-0.030***
		(-3.30)
Kleibergen-Paap rk Wald F	21.71	15.74
Observations	14,993	13,053
Industry Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes

Table 5
Customer stock price, customer investment, and supplier R&D

Panel A examines the effect of customer stock prices on the customer's own R&D and capital expenditure. We present estimates of 2SLS regressions. In the first stage, the dependent variable is *Customer Q* and the instrument is *Customer MFFlow*. In the second stage, the dependent variable is *Customer R&D*, *Customer CAPEX* in year t+1 in Column 2 and 4, respectively. Panel B presents estimates from 2SLS regressions exploring how the customer's cut in investment in R&D affects the supplier firm's R&D investment policy. We present estimates from 2SLS regression where the endogenous variables are *Customer R&D* (Column 1 and 2), *Customer CAPEX* (Column 3 and 4) in year t+1, respectively and the instrument is *Customer MFFlow*. In the second stage, the dependent variable is *Supplier R&D* in year t+1. Other than supplier's and customer's characteristics included in the previous tables, we also control for the customer's *R&D*, *CAPEX*, and *Takeover* in the model when they are not taken as the endogenous variable. The regressions are estimated among the biggest customers based on reported sales from year t-3 to t-1. All the variables are defined in the Appendix. Year and customers' Fama-French 48 industry dummies are also included. t-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

Panel A: Customer's Stock Price and Customer's Investment.

Stage:	1st	2nd	1st	2nd
Dependent Variable:	Customer Q	Customer R&D	Customer Q	Customer CAPEX
	(1)	(2)	(3)	(4)
Customer MFFlow	0.061***		0.060***	
	(5.71)		(5.65)	
Customer Q		0.065***		0.153***
		(5.53)		(3.92)
Customer Ln*(Assets)*	-0.041***	0.002**	-0.038***	-0.010***
	(-5.55)	(2.54)	(-5.09)	(-5.22)
Customer Leverage	-0.849***	-0.011	-0.863***	0.017
	(-10.99)	(-0.99)	(-11.19)	(0.48)
Customer ROA	6.003***	-0.374***	6.214***	-0.585**
	(27.43)	(-5.30)	(28.07)	(-2.44)
Customer Sales Growth	0.632***	-0.024***	0.631***	0.136***
	(9.12)	(-2.81)	(8.84)	(4.79)
Customer Sales Volatility	0.041	-0.008	0.065	0.047**
	(0.51)	(-1.46)	(0.80)	(2.36)
Customer Herfindahl	0.174**	-0.039***	0.173**	-0.109***
	(2.11)	(-6.93)	(2.09)	(-6.69)
Adjusted r^2	0.325		0.336	
Kleibergen-Paap rk Wald F	32.63		31.93	
Observations	15,089	15,089	14,736	14,736
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes

(continued)

Panel B: Customer's Investment and Supplier's R&D.

Stage:	1st	2nd	1st	2nd
Dependent Variable:	Customer R&D	Supplier R&D	Customer CAPEX	Supplier R&D
	(1)	(2)	(3)	(4)
Customer MFFlow	0.007***		0.005**	
	(11.26)		(2.41)	
Instrumented Customer $R\&D_{t+1}$		0.418**		
		(2.31)		
Instrumented Customer $CAPEX_{t+1}$				0.157
				(0.63)
Customer R&Dt+1			0.725***	0.177
			(13.60)	(0.95)
Customer CAPEXt+1	0.065***	-0.016		
	(13.27)	(-1.09)		
Customer Takeovert+1	-0.004*	-0.000	-0.016**	0.002
	(-1.74)	(-0.08)	(-2.27)	(0.26)
Customer Ln*(Assets)*	-0.001*	-0.001	-0.005***	0.000
	(-1.71)	(-0.91)	(-4.41)	(0.13)
Customer Leverage	-0.091***	0.020	-0.037***	0.015
	(-22.39)	(1.12)	(-2.72)	(1.20)
Customer ROA	0.012	0.020	0.259***	-0.021
	(1.10)	(1.05)	(9.13)	(-0.32)
Customer Sales Growth	-0.008**	0.000	0.257***	-0.043
	(-2.30)	(0.05)	(19.87)	(-0.66)
Customer Sales Volatility	-0.055***	-0.006	0.135***	-0.034
	(-10.49)	(-0.45)	(8.09)	(-0.96)
Customer Herfindahl	-0.026***	-0.020**	-0.048***	-0.015
	(-7.01)	(-2.35)	(-4.48)	(-1.08)
Ln*(Assets)*	-0.000	-0.002***	0.003***	-0.003**
	(-0.05)	(-2.84)	(3.28)	(-2.36)
Leverage	-0.008***	-0.050***	-0.013**	-0.049***
	(-3.59)	(-7.73)	(-2.10)	(-6.72)
Supplier Q	-0.000	0.015***	0.003***	0.015***
	(-0.93)	(12.78)	(3.12)	(10.53)
ROA	-0.011***	-0.097***	0.011*	-0.100***
	(-5.00)	(-13.02)	(1.73)	(-12.77)
Sales Growth	0.003***	0.006**	-0.000	0.006***
	(3.93)	(2.49)	(-0.14)	(2.70)
Sales Volatility	-0.002	-0.026***	0.026***	-0.031***
	(-0.88)	(-4.76)	(3.96)	(-3.48)

(continued)

Table 5, Panel B (continued)

Herfindahl	-0.010**	-0.027***	-0.010	-0.026***
	(-2.42)	(-3.53)	(-1.01)	(-3.33)
Adjusted r^2	0.212		0.248	
Kleibergen-Paap rk Wald F	126.86		5.80	
Observations	14,796	14,796	14,796	14,796
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes

Table 6
Customer stock price and supper R&D - high and low stock price informativeness

This table examines the impact of an exogenous change in the customer's stock valuation on supplier R&D, where customer valuation is allowed to vary across customers with high and low stock price informativeness (Chen, Goldstein and Jiang (2007)). We present the second stage of 2SLS estimates. In the first stage, the dependent variables are interaction terms between *Customer Q* and binary variables indicating firms with above/below the sample median of $1\text{-}R^2$ in year t-1. The instruments are interaction terms between *Customer MFFlow* and binary variables indicating firms with above/below the sample median of $1\text{-}R^2$ in year t-1. In the second stage, the dependent variable is *Supplier R&D* in year t+1. For each firm-year we find the biggest customer based on reported sales from year t-3 to t-1. All the variables are defined in the Appendix. Year and Fama-French 48 industry dummies are also included. t-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

	(1)	(2)
Customer Q × *High* $1\text{-}R^2$	0.087***	0.062***
	(3.78)	(2.88)
Customer Q × Low 1-R2	0.028	0.009
	(0.83)	(0.30)
High 1-R2	-0.095	-0.093
	(-1.06)	(-1.23)
Customer Ln*(Assets)*	0.001	0.000
	(0.17)	(0.18)
Customer Leverage	0.008	0.001
	(0.32)	(0.05)
Customer ROA	-0.350***	-0.192*
	(-2.90)	(-1.74)
Customer Sales Growth	-0.051***	-0.042***
	(-2.87)	(-2.59)
Customer Sales Volatility	-0.019	-0.018
	(-1.02)	(-1.12)
Customer Herfindahl	-0.005	-0.004
	(-0.24)	(-0.26)
Ln*(Assets)*		-0.002***
		(-2.95)
Leverage		-0.048***
		(-6.25)
Supplier Q		0.014***
		(9.89)

(continued)

Table 6 (continued)		
ROA		-0.092***
		(-10.41)
Sales Growth		0.005
		(1.47)
Sales Volatility		-0.024***
		(-3.65)
Herfindahl		-0.035***
		(-3.66)
Kleibergen-Paap rk Wald F	8.04	7.77
Observations	14,438	12,593
Industry Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes

Table 7
Customer stock price and supplier R&D - high and low PIN

This table examines the impact of an exogenous change in the customer's stock valuation on supplier R&D, where customer valuation is allowed to vary across the customer's probability of informed trading (PIN) (Duarte and Young (2009)). We present the second stage of 2SLS estimates. In the first stage, the dependent variables are interaction terms between *Customer Q* and binary variables indicating firms with above or below median level of financial constraint proxies. The instruments are interaction terms between *Customer MFFlow* and binary variables indicating firms with above or below median level of financial constraint proxies. In the second stage, the dependent variable is *Supplier R&D* in year t+1. For each firm-year we find the biggest customer based on reported sales from year t-3 to t-1. We use two different proxies for financial constraint: *WW Index*, and *SA Index*. All the variables are defined in the Appendix. Year and Fama-French 48 industry dummies are also included. t-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

	(1)	(2)
Customer Q × High Customer PIN	0.080*	0.066
	(1.72)	(1.42)
Customer Q × Low Customer PIN	0.029	0.005
	(0.85)	(0.15)
High Customer Pin	-0.085	-0.102
	(-0.90)	(-1.04)
Customer Ln*(Assets)*	0.002	0.002
	(0.93)	(1.06)
Customer Leverage	0.020	0.013
	(0.92)	(0.62)
Customer ROA	-0.339	-0.192
	(-1.52)	(-0.84)
Customer Sales Growth	-0.052**	-0.047*
	(-2.00)	(-1.72)
Customer Sales Volatility	-0.004	-0.014
	(-0.17)	(-0.54)
Customer Herfindahl	-0.012	-0.004
	(-0.81)	(-0.25)
Ln*(Assets)*		-0.002**
		(-2.00)
Leverage		-0.048***
		(-5.69)

(continued)

Table 7 (continued)

Supplier Q		0.015***
		(8.90)
ROA		-0.091***
		(-7.63)
Sales Growth		0.008**
		(2.41)
Sales Volatility		-0.024***
		(-2.82)
Herfindahl		-0.014
		(-1.38)
Kleibergen-Paap rk Wald F	5.31	4.00
Observations	10,411	8.912
Industry Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes

Table 8

Customer stock price, customer takeover threats, and supplier R&D

Panel A shows that stock underpricing of the customer firm due to mutual fund flow increases the likelihood of the customer becoming a takeover target. We present estimates of a 2SLS probit regression. In the first stage, the dependent variable is *Customer Q* and the instrument is *Customer MFFlow*. In the second stage, the dependent variable is *Customer Takeover* in year t+1. Panel B presents estimates from 2SLS regressions to show that customer's takeover likelihood affect supplier firms' R&D investment policy. In the first stage, we run a probit regression where the endogenous variables is *Customer Takeover* in year t+1. In the second stage, the dependent variable is *Supplier R&D* in year t+1. Other than supplier's and customer's characteristics included in the previous tables, we also control for the customer's *R&D*, *CAPEX*. The regressions are estimated among the biggest customers based on reported sales from year t-3 to t-1. All the variables are defined in the Appendix. Year and customers' Fama-French 48 industry dummies are also included. Cragg-Donald Wald F statistic is estimated based on linear 2SLS model. z-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

Panel A: Customer's Stock Price and Customer's Takeover Threat.

Stage:	1st	2nd
Dependent Variable:	Customer Q	Customer Takeover
	(1)	(2)
Customer MFFlow	0.052***	
	(4.18)	
Customer Q		-1.156***
		(-6.92)
Customer Ln(Assets)	-0.133***	-0.148***
	(-10.95)	(-4.79)
Customer Leverage	-0.650***	-0.665***
	(-7.24)	(-3.36)
Customer ROA	5.751***	4.356***
	(25.22)	(2.93)
Customer Sales Growth	0.656***	0.710***
	(9.48)	(3.96)
Customer Sales Volatility	-0.067	-0.505**
	(-0.80)	(-2.49)
Customer Herfindahl	0.120	0.030
	(1.39)	(0.17)
Customer Inst. Ownership	-0.675***	0.132
	(-9.44)	(0.34)
Customer Amihud	-0.160***	-0.117**
	(-11.28)	(-2.19)
Constant	4.206***	3.774***
	(6.79)	(3.29)
Kleibergen-Paap rk Wald F	13.22	
Observations	12,857	12,857
Industry Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes

(continued)

Table 8 (continued)

Panel B: Customer's Takeover Threat and Supplier's R&D.

Stage:	1st	2nd
Dependent Variable:	Customer Takeover	Supplier R&D
	(1)	(2)
Customer MFFlow	-0.078**	
	(-2.36)	
Instrumented Customer Takeover$_{t+1}$		-0.059**
		(-1.98)
Customer R&D$_{t+1}$	-1.258*	0.307***
	(-1.78)	(7.86)
Customer CAPEX$_{t+1}$	-0.731***	-0.010
	(-3.39)	(-1.21)
Customer Ln*(Assets)*	-0.003	0.000
	(-0.13)	(0.08)
Customer Leverage	0.242	0.013
	(1.15)	(1.51)
Customer ROA	-3.363***	0.016
	(-7.93)	(0.73)
Customer Sales Growth	0.137	0.001
	(0.80)	(0.21)
Customer Sales Volatility	-0.849***	-0.013
	(-3.11)	(-1.17)
Customer Herfindahl	-0.675***	-0.025***
	(-3.66)	(-3.48)
Customer Inst. Ownership	1.245***	0.001
	(7.12)	(0.20)
Customer Amihud	0.047	0.002
	(1.38)	(1.21)
Ln*(Assets)*	-0.026*	-0.002***
	(-1.67)	(-3.26)
Leverage	0.008	-0.053***
	(0.08)	(-7.90)
Supplier Q	0.019	0.015***
	(1.25)	(14.98)
ROA	0.008	-0.096***
	(0.07)	(-12.44)
Sales Growth	0.052	0.006*
	(1.08)	(1.76)

(continued)

Table 8, Panel B (continued)

Sales Volatility	-0.079	-0.027***
	(-0.67)	(-4.76)
Herfindahl	0.239	-0.027***
	(1.37)	(-3.74)
Constant	-5.560	0.037
	(-0.06)	(1.55)
Adjusted r^2	0.161	
Kleibergen-Paap rk Wald F	133.15	
Observations	12,825	12,825
Industry Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes

Table 9
Customer stock price and supplier R&D - anti-takeover provisions

This table examines the impact of an exogenous change in the customer's stock valuation on supplier R&D, where customer valuation is allowed to vary across customers with high and low numbers of anti-takeover defense provisions (Gompers, Ishii, Metrick (2003)). We present the second stage of 2SLS estimates. In the first stage, the dependent variables are interaction terms between *Customer Q* and binary variables indicating firms with 10 or fewer anti-takeover provisions. The instruments are interaction terms between *Customer MFFlow* and binary variables indicating firms with 10 or fewer anti-takeover provisions. In the second stage, the dependent variables is *Supplier R&D* in year t+1. For each firm-year we find the biggest customer based on reported sales from year t-3 to t-1. All the variables are defined in the Appendix. Year and Fama-French 48 industry dummies are also included. t-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

	(1)	(2)
Customer Q × Low GIndex	0.064***	0.044**
	(2.64)	(2.01)
Customer Q × High GIndex	-0.012	-0.004
	(-0.23)	(-0.09)
Low GIndex	-0.164	-0.102
	(-1.14)	(-0.84)
Customer Ln*(Assets)*	0.002	0.003
	(0.67)	(1.00)
Customer Leverage	0.040*	0.033
	(1.67)	(1.51)
Customer ROA	-0.225	-0.149
	(-1.61)	(-1.16)
Customer Sales Growth	-0.051***	-0.041***
	(-2.72)	(-2.59)
Customer Sales Volatility	-0.014	-0.013
	(-0.63)	(-0.67)
Customer Herfindahl	-0.082**	-0.056*
	(-2.17)	(-1.84)
Ln*(Assets)*		-0.004***
		(-3.61)
Leverage		-0.052***
		(-4.13)
Supplier Q		0.016***
		(8.94)
ROA		-0.094***
		(-8.06)

(continued)

Table 9 (continued)

Sales Growth		0.001
		(0.34)
Sales Volatility		-0.032***
		(-3.55)
Herfindahl		-0.030**
		(-2.14)
Kleibergen-Paap rk Wald F	3.20	2.47
Observations	7,899	6,777
Industry Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes

Table 10

Robustness tests

This table tests whether our main findings are robust to the use of alternative industry concentration measures and the inclusion of firm fixed effects. In the first stage, the dependent variable is *Customer Q* and the instrument is *Customer MFFlow*. In the second stage, the dependent variable is *Supplier R&D* in year t+1. For each firm-year we find the biggest customer based on reported sales from year t-3 to t-1. All the variables are defined in the Appendix. t-statistics using robust, firm-clustered standard errors are in parentheses. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

Herfindahl Measures:	*HHI (SIC4)*	*HHI (SIC3)*		*Fitted HHI (SIC3)*		*FIC HHI*		*TNIC HHI*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Customer Q	0.035*	0.046**	0.036*	0.040**	0.031*	0.033***	0.027*	0.030***	0.023*
	(1.95)	(2.45)	(1.88)	(2.39)	(1.95)	(3.05)	(1.81)	(3.02)	(1.77)
Customer Ln*(Assets)*	0.003*	0.003*	0.003	0.001	0.002	0.001	0.001	0.001	0.002
	(1.65)	(1.88)	(1.62)	(1.37)	(1.36)	(0.82)	(0.50)	(0.86)	(0.75)
Customer Leverage	0.034*	0.020	0.034*	0.028	0.038**	0.044*	0.027	0.045*	0.032
	(1.85)	(1.08)	(1.82)	(1.53)	(2.24)	(1.86)	(1.11)	(1.95)	(1.30)
Customer ROA	-0.129	-0.285**	-0.129	-0.243**	-0.116*	-0.212**	-0.050	-0.188**	-0.044
	(-1.60)	(-2.16)	(-1.54)	(-2.10)	(-1.69)	(-2.43)	(-0.84)	(-2.32)	(-0.79)
Customer Sales Growth	-0.012	-0.030**	-0.012	-0.021*	-0.002	-0.028**	0.001	-0.026**	0.003
	(-1.21)	(-2.25)	(-1.17)	(-1.78)	(-0.26)	(-2.27)	(0.09)	(-2.16)	(0.21)
Customer Sales Volatility	-0.005	-0.005	-0.005	-0.003	-0.005	-0.002	-0.030*	-0.003	-0.029*
	(-0.57)	(-0.40)	(-0.60)	(-0.21)	(-0.58)	(-0.09)	(-1.74)	(-0.16)	(-1.73)
Customer Herfindahl	-0.006	-0.018	-0.002	-0.072	-0.003	-0.014	0.001	-0.020*	-0.001
	(-0.61)	(-1.02)	(-0.12)	(-0.79)	(-0.03)	(-1.42)	(0.08)	(-1.74)	(-0.06)
Ln*(Assets)*	-0.018***	-0.002***	-0.018***	-0.002***	-0.019***	-0.005***	-0.029***	-0.007***	-0.029***
	(-6.55)	(-2.87)	(-6.47)	(-2.65)	(-6.41)	(-3.54)	(-6.19)	(-5.08)	(-6.60)
Leverage	-0.014	-0.047***	-0.014	-0.056***	-0.019*	-0.041***	-0.041**	-0.039***	-0.047***
	(-1.61)	(-6.29)	(-1.61)	(-6.44)	(-1.85)	(-2.59)	(-2.43)	(-2.75)	(-2.98)

(continued)

Table 10 (continued)

Supplier Q	0.006***	0.014***	0.006***	0.014***	0.006***	0.018***	0.005**	0.017***	0.005**
	(4.27)	(10.56)	(4.24)	(9.85)	(4.20)	(9.72)	(2.29)	(9.87)	(2.57)
ROA	0.002	-0.088***	0.002	-0.087***	0.006	-0.099***	-0.002	-0.096***	-0.001
	(0.32)	(-9.98)	(0.33)	(-9.34)	(0.81)	(-8.12)	(-0.16)	(-8.28)	(-0.10)
Sales Growth	0.000	0.006**	0.000	0.006**	-0.000	-0.007	-0.010**	-0.006	-0.009**
	(0.10)	(2.13)	(0.10)	(2.06)	(-0.10)	(-1.41)	(-2.40)	(-1.32)	(-2.20)
Sales Volatility	-0.012*	-0.025***	-0.012*	-0.024***	-0.015**	-0.037***	-0.009	-0.039***	-0.011
	(-1.93)	(-3.90)	(-1.92)	(-3.45)	(-2.40)	(-3.61)	(-0.93)	(-4.09)	(-1.36)
Herfindahl	-0.011	-0.021*	-0.005	0.060	0.010	-0.001	-0.002	-0.075***	-0.025***
	(-1.23)	(-1.91)	(-0.45)	(0.89)	(0.14)	(-0.12)	(-0.18)	(-8.42)	(-2.78)
Kleibergen-Paap rk Wald F	29.68	39.00	27.18	45.17	32.20	76.96	36.22	90.79	43.04
Observations	12,237	13,053	12,237	10,401	9,636	4,131	3,606	4,382	3,854
Firm Fixed Effects	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Industry Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes	No
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 11
Supplier stock price and customer portfolio R&D

This table examines the relation between exogenous supplier stock valuation due to mutual fund flow and the R&D levels of its customer portfolio. In the first stage, the dependent variable is *Supplier Q* and the instrument is *Supplier MFFlow*. In the second stage, the dependent variable is *Customer R&D* in year t+1. For each firm-year we compute the average characteristics of all reported customers weighted by sales. All the variables are defined in the Appendix. Year and Fama-French 48 industry dummies are also included. t-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

Stage:	1st	2nd	1st	2nd
Dependent Variable:	Supplier Q	Customer R&D	Suplier Q	Customer R&D
	(1)	(2)	(3)	(4)
Supplier MFFlow	0.070***		0.042***	
	(15.01)		(10.32)	
Supplier Q		0.006**		0.005
		(2.52)		(1.38)
Customer Ln*(Assets)*	-0.057***	0.003***	-0.024**	0.003***
	(-4.56)	(8.82)	(-2.13)	(9.05)
Customer Leverage	-0.595***	-0.102***	-0.341**	-0.098***
	(-3.60)	(-22.89)	(-2.12)	(-22.34)
Customer ROA	-0.628*	-0.088***	-0.115	-0.081***
	(-1.92)	(-8.26)	(-0.37)	(-7.67)
Customer Q	0.221***	0.016***	0.142***	0.015***
	(8.28)	(15.46)	(5.95)	(14.65)
Customer Sales Growth	0.461***	0.008***	0.289***	0.008***
	(4.36)	(2.80)	(2.89)	(2.86)
Customer Sales Volatility	0.075	-0.023***	0.279	-0.022***
	(0.34)	(-5.72)	(1.28)	(-5.06)
Ln*(Assets)*			-0.094***	0.000
			(-6.48)	(-0.83)
Leverage			-0.862***	-0.017***
			(-6.73)	(-4.13)
ROA			-0.878***	-0.005
			(-6.52)	(-1.22)
Sales Growth			0.504***	-0.003
			(14.14)	(-1.25)
Sales Volatility			0.589***	-0.005*
			(5.55)	(-1.70)
Herfindahl			-0.489***	-0.025***
			(-3.68)	(-5.73)

(continued)

Table 11 (continued)				
Adjusted r^2	0.04		0.143	
Kleibergen-Paap rk Wald F	225.16		106.57	
Observations	17,378	17,378	17,100	17,100
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes