Customers' Risk Tolerance and Suppliers' Investment Inefficiency

Hrazdil, Karel; Kim, Jeong-Bon; Li, Xin

Published in:
Journal of Risk and Financial Management

Published: 01/02/2022

Published version (DOI):
10.3390/jrfm15020063

Publication details:
Hrazdil, K., Kim, J-B., & Li, X. (2022). Customers' Risk Tolerance and Suppliers' Investment Inefficiency. *Journal of Risk and Financial Management*, *15*(2), [63]. https://doi.org/10.3390/jrfm15020063

Journal of
Risk and Financial Management

MDPI

Article

Customers' Risk Tolerance and Suppliers' Investment Inefficiency

Karel Hrazdil [1,*], Jeong-Bon Kim [2] and Xin Li [1]

1 Beedie School of Business, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; xin_li_12@sfu.ca
2 College of Business, City University of Hong Kong, Kowloon, Hong Kong 999077, China; jeongkim@cityu.edu.hk
* Correspondence: karel_hrazdil@sfu.ca

Abstract: We examine the effect of the risk tolerance of downstream firms (i.e., customers) on the investment inefficiency of upstream firms (i.e., suppliers). Using the pilot licensing status of the CEOs as a proxy for their inherent risk tolerance, we find that customer firms led by pilot CEOs are associated with suppliers' investment inefficiency, where investment inefficiency is more pronounced when the suppliers have less bargaining power over their customers. Our dynamic analysis confirms the causative relation between customer risk tolerance and supplier investment inefficiency and suggests that customers' risk tolerance plays a significant role in shaping suppliers' relationship-specific investment strategies.

Keywords: risk tolerance; pilot; CEO; customer; supply chain; supplier inefficiency

Citation: Hrazdil, Karel, Jeong-Bon Kim, and Xin Li. 2022. Customers' Risk Tolerance and Suppliers' Investment Inefficiency. *Journal of Risk and Financial Management* 15: 63. https://doi.org/10.3390/jrfm15020063

Academic Editor: Cristina Raluca Gh. Popescu

Received: 31 December 2021
Accepted: 28 January 2022
Published: 1 February 2022

1. Introduction

Firms that are economically linked are likely to influence the decisions of one another. Previous studies have provided ample evidence that demonstrates how the personality attributes of chief executive officers (CEOs) shape corporate decisions and influence employees, communities, environments, and other stakeholders (Hambrick 2007). For example, studies have shown that firms led by charismatic leaders are associated with increased investments (Flynn and Staw 2004), while CEO narcissism has positive effects on corporate social responsibility (CSR) investments and performance (Kets de Vries and Miller 1985; Petrenko et al. 2016). Other studies have demonstrated that risk-tolerant CEOs are more likely than risk-averse CEOs to undertake acquisitions and receive a larger proportion of their compensation in the form of stocks, bonuses, and options as opposed to salaries (e.g., Graham et al. 2013). Within the supply chain domain, suppliers' investments are usually relationship-specific (e.g., Williamson 1983; Joskow 1987; DuHadway et al. 2018) and tailored for specific customers; however, extant research lacks evidence about the spillover effects of CEO personality attributes along the company's supply chain. To address this knowledge gap, we investigate whether and, if so, how an important innate personality trait, namely the risk tolerance of CEOs of customer firms (hereinafter "customer CEOs"), is associated with supplier firms' investment inefficiency.

The supplier–customer relationship and its impact on investment inefficiency is an important and widely researched topic. The customer-specific relationships of upstream firms (suppliers) place them in a disadvantageous position because they usually first need to acquire the required capacities and invest in fixed assets to support production for their customers in the absence of formal contracts (Levin 2003). As a supplier's investment is generally relationship-specific or customer-tailored, it has limited choices outside of a specific supplier–customer relationship (Williamson 1983; Joskow 1987). In other words, the supplier must bear the cost incurred by the customer's re-negation, while the customer can extract some of the supplier's quasi-rents (Tirole 1999; Baiman et al. 2001). With the expectation of such disadvantageous position within the supplier–customer relationship, the supplier has less ex ante incentives to invest. As a consequence, it leads to the classic "hold-up" problem (Klein et al. 1978; Grossman and Hart 1986; Hart and Moore 1988, 1990). When suppliers face riskier customers, they have less bargaining power in their relationships, which further exacerbates their underinvestment problem.

From the customer firm's standpoint, it is spontaneous for the customer to amplify its demand, thus prompting the supplier to overinvest (Lee et al. 1997; Cachon and Lariviere 2001; Chatfield et al. 2004). In a specific supplier–customer relationship, the supplier develops its production capacity based on the expected demand from customers without a legal contract. In case of a high unanticipated future demand, the customer has a natural tendency to overstate its demand to prevent inventory stock-out; meanwhile, the customer does not bear the costs of the supplier's surplus. Consequently, when negotiating with the supplier in advance, the customer tends to demonstrate the "boost-up" tendency that entails raising their demand information. This inflation by customers of their demands leads to the problem of overinvestment for the potential supplier, as documented in the literature (e.g., Lee et al. 1997; Cachon and Lariviere 2001; Chatfield et al. 2004). Given the above background, we argue that customers that are more risk-tolerant are likely to overinvest and further boost up their demands, thereby exacerbating the supplier's overinvestment problem.

Both underinvestment and overinvestment are forms of investment inefficiency. The suppliers may either underinvest or overinvest, depending on their expectations regarding their customers' abilities to fulfill their purchasing contracts. In a repeated game setting, reneging exposes the customer to the risk of the supplier's suspension of future cooperation. Such reputational considerations impose natural market constraints on "bad behavior" ex post (Joskow 1987). However, when the current value of the reputational premium exceeds the loss from the suspension of future cooperation with suppliers, customers will not break the ex ante informal agreement and boost up their demand. For customers that face financial distress or other operational risks, the expected gains from reneging are likely to exceed the cost of expected "punishment", thereby leading to a higher likelihood that these customers will inflate their future demands (Dou et al. 2013). Knowing this, suppliers naturally respond by underinvesting. In a similar vein, when suppliers are faced with riskier customers, they are more likely to underinvest in anticipation of volatile future demands associated with more risk-tolerant customers.

The existing literature suggests that managers' innate personality traits or attributes play a significant role in shaping a variety of corporate decisions. According to upper echelons theory, the manner in which individual decision makers interpret the situations, challenges, or decisions that confront them is influenced by their experiences, values, and personalities, which may, in turn, influence their strategic choices and organizational effectiveness (Hambrick 2007). Among the executive personality traits associated with customers' abilities to fulfill their informal purchasing agreements, sensation-seeking is one of the predominant personality attributes that are predictive of unethical behaviors (Dahlen et al. 2005). This personality trait is predominantly expressed as a risky behavior. The findings of previous studies suggest that a CEO's sensation-seeking behavior in non-economic contexts could plausibly reveal information about corporate policy choices that impact on firm risk (Zuckerman 1971; Grinblatt and Keloharju 2009). Recently, researchers have begun to utilize the pilot licensing status of a CEO as a proxy for his or her inherent risk tolerance (or sensation seeking). For example, Cain and McKeon (2016) found that firms led by pilot CEOs have higher levels of equity return volatility, whereas Sunder et al. (2017) found that firms led by pilot CEOs experience better returns on R&D investments. Referring to this literature, we use the pilot licensing status of the customer CEO as a proxy for executive risk tolerance.[1] We postulate that suppliers could assess their customers' ability to fulfill purchasing contracts based on their executives' ability to tolerate and manage risk.

Our study integrates two research streams: one focusing on the supplier–customer relationship and the other on CEOs' personalities to investigate the spillover effects of CEOs' risk tolerance along companies' supply chains. Specifically, we examine how customers' risk tolerance, proxied by the pilot licensing status of a customer CEO, affects the suppliers' investment inefficiency, characterized by either underinvestment or overinvestment, depending on their expectations about the customers' abilities to fulfill their purchasing contracts.

We test the relationship between customer CEOs' risk tolerance and suppliers' investment inefficiency using data compiled for the period 1999–2017. Following Cain and McKeon (2016) and Sunder et al. (2017), we measure CEOs' identified preferences for risk, using an updated dataset on CEOs who hold aircraft pilot licenses. Following Biddle et al. (2009) and Chiu et al. (2019), we measure investment inefficiency based on deviations from the expected investments relating to firms' investment opportunities. Specifically, we estimate the expected investment level according to the function of growth opportunities for each industry-year and use the residuals as a firm-specific proxy for deviations from expected investments to measure investment inefficiency. Our main multinomial logistic model shows that a risk-tolerant customer led by a CEO pilot is associated with suppliers' investment inefficiency (underinvestment and overinvestment). The key findings of the study indicate that both the suppliers' "hold-up" problem and the customer "boost-up" tendency lead to investment inefficiency. In other words, suppliers' investments are more volatile when they are faced with customer firms led by pilot CEOs (who are more risk-tolerant). We control firms' risk profiles through their sensitivities to stock return volatility (Vega) and to stock price (Delta) and document that the pilot status of CEO still influences suppliers' investment efficiency even after controlling for the incentives induced by managerial compensation structure. The results of our cross-sectional analyses further indicate that suppliers' investment inefficiency associated with customer risk tolerance is stronger when suppliers have less bargaining power, and in specific suppliers that are smaller or faced with more concentrated customers. Finally, our dynamic analysis confirms that the variations in supplier investment efficiency, specifically supplier underinvestment, are caused by the turnovers in the pilot status of customer CEOs.

Our findings make several important contributions to two streams of existing literature. First, our study fills the research gap about the spillover effect of customer CEO's personality in the supply chain literature. To the best of our knowledge, our study is the first to document a significant relation between customer CEOs' risk tolerance and suppliers' investment inefficiency. Unlike previous studies that focus primarily on the quality of customer firms' financial reporting, whether quantitative or qualitative (e.g., Biddle et al. 2009; Chiu et al. 2019), our investigation focuses on whether and how the risk tolerance of an *individual* customer CEO's risk tolerance, which is an innate personality trait, influences suppliers' investment behaviors. The key point in our paper is that one of CEOs' inherent personality traits, that is, risk tolerance captured by pilot CEOs, affects their investment decision even after controlling for the structure of incentive compensation. Accordingly, our major contribution is the investigation of how personal attributes of managers at one firm affect corporate policy at other firms with whom they interact (e.g., their suppliers). In contrast, most existing research has focused on the role that managers play in shaping decisions at their own firms (e.g., Brown et al. 2018; Cain and McKeon 2016; Sunder et al. 2017). We find that suppliers' investments are more volatile when customer CEOs exhibit higher levels of risk tolerance. Our empirical results support both the "hold-up" tendency of suppliers and the "boost-up" tendency of customers in investment decisions when faced with potential risks and uncertainties associated with the risk-tolerance of customer CEOs. This is because CEOs' risk-taking tendency could cause greater cash flow and operational uncertainties, which, in turn, hurts suppliers' ability to make optimal investment decisions. Furthermore, the cross-sectional tests suggest that when suppliers have less bargaining power over their customers and face higher levels of demand uncertainty, fluctuations in suppliers' investment inefficiency are more pronounced when they face riskier customers.

Second, our findings complement the emerging literature on the effects of CEOs' inherent personality traits and support the appropriateness of using pilot licensing status as a proxy for executive risk preferences. Previous studies document that firms led by pilot CEOs experience higher equity return volatility, are more innovative, and exhibit lower

CSR performance levels (Cain and McKeon 2016; Sunder et al. 2017; Hrazdil et al. 2020). We contribute to this literature by showing that suppliers' investment inefficiency is induced by their customers' risk tolerance through underinvestment.

The paper is organized as follows. In Section 2, we review the related literature and develop the hypothesis for the study. In Section 3, we describe the sample, variable construction process, and empirical models used in the study. The main results, cross-sectional analyses, and robustness checks are presented in Section 4, and Section 5 presents the conclusions of the study.

2. Related Literature and Theoretical Development

2.1. Literature on Supply Chains

The supplier–customer relationship entails a dynamic, long-term mechanism, wherein the supplier firm usually moves first to acquire capacity and makes investments to support production for its customers without entering into a formal contract. When making investment decisions in advance, the supplier typically specifies the price, production capacity, or production quantity to the customer (Levin 2003; Tirole 1999; Taylor and Plambeck 2007). Thus, supply chain investments are usually relationship-specific (DuHadway et al. 2018). A higher level of relationship-specificity of the investment corresponds to a lower value of the investment outside of the specific customer–supplier relationship (Williamson 1975). Therefore, if the customer reneges on its previous informal contract, the supplier will bear the cost of overinvestment because such relationship-specific investments have no alternative uses in most cases (Williamson 1983; Joskow 1987). The disadvantageous position of suppliers in this supply chain relationship leads to a reduction in their ex ante investment incentives, leading to underinvestment or what economists refer to as the "hold-up" problem (Klein et al. 1978; Grossman and Hart 1986; Hart and Moore 1988, 1990).

Unlike suppliers, customers are naturally inclined to amplify demand information, which leads to the overinvestment problem for suppliers (Lee et al. 1997; Cachon and Lariviere 2001; Chatfield et al. 2004). In general, suppliers form their production capacities based on the demand forecasts provided by customers in advance. Because customers bear neither the cost of suppliers' surplus nor the legal responsibility from the informal contract beforehand, they prefer their suppliers to have sufficient capacity to prevent inventory stock-out in case of high future demands. As customers are prioritized in the appropriation of the surplus generated by the suppliers' investments, they are likely to "boost-up" their demand information when negotiating with their suppliers in advance. Depending on their size, they have relatively strong bargaining power and can exert considerable pressure on suppliers to overinvest (Porter 1974; Cachon and Terwiesch 2012).

Investment inefficiency entails either underinvestment or overinvestment by suppliers, depending on their expectations about the ability of their customers to fulfill their purchasing contracts. If the customer reneges on the contract, the supplier incurs losses because of over (under) capacity. As a result, the supplier may refuse to cooperate in the future. The customers therefore suffer the reputation risk and aim to provide reasonable demand to maintain a long-term customer–supplier relationship. In equilibrium, ex ante reputational considerations impose a natural market constraint on ex post "bad behavior" (Joskow 1987). However, such reputational constraints are less effective when customers are in distress or when their risk tolerance is high, as they may care less about future gains from a good supplier–customer relationship (Chiu et al. 2019).

Customer overinvestment tendency is further exacerbated by their risk tolerance. Specifically, customers who are more risk-tolerant are more likely to overinvest and boost up their demand for suppliers' products and services, which induces suppliers to overinvest. As a response, when suppliers anticipate that the level of their customers' risk tolerance is relatively high, they may make more conservative investment decisions. On the other hand, suppliers are inevitably affected by customers' demand from the informal contract and may be therefore inclined to produce more capacity. In equilibrium, optimal relational contracts can reduce customers' incentives to renege on purchase contracts by imposing reputational risk on customers and mitigate the hold-up problem faced by the suppliers (Taylor and Plambeck 2007). However, the contractual arrangement can be very complex and therefore hard to implement in reality because of transaction costs. Given that investment inefficiencies are bi-directional (underinvestments or overinvestments), our analysis aims to shed light on suppliers' potential underinvestment or overinvestment when faced with customers whose risk tolerance is relatively high.

2.2. Literature on Pilot CEOs

Upper echelons theory posits that individual decision makers' interpretations of situations, challenges, or decisions are influenced by their experiences, values, and personalities, which, in turn, influence their strategic choices and organizational effectiveness (Hambrick 2007). Accordingly, CEOs' innate personality traits play a significant role in shaping corporate strategies. Previous research reveals that measurable personal characteristics of CEOs have significant explanatory power relating to corporate financial reporting and decisions (Plöckinger et al. 2016). For example, Ham et al. (2017) examined the sizes of the notarized signatures of chief financial officers (CFOs) to estimate the effect of narcissism on financial reporting quality. Malmendier et al. (2011) investigated the effects of both capital structure-related beliefs (overconfidence) and formative early-life experiences (e.g., military service) on financial policies. Hribar and Yang (2016) examined how overconfidence affects the properties of management forecasts, while Kim et al. (2016) determined that the risk of stock price crashes is higher for firms with overconfident CEOs.

Among the innate personality traits of the customer CEOs that relate to the firms' ability to fulfill their informal purchasing agreements, the level of their risk tolerance or risk-seeking is influential in predictions of CEOs' unethical behaviors (Dahlen et al. 2005). Others, such as DuHadway et al. (2018), document that supply chain employees make riskier decisions when their organization communicates improvements in supply chain risk levels. Previous studies suggest that a CEO's risk-seeking behavior in non-economic contexts could plausibly contain information about the CEO's corporate policy choices that impact on firm risk (Zuckerman 1971; Grinblatt and Keloharju 2009). Thus, suppliers can assess their customers' abilities to fulfill contracts based on their executives' personal preferences regarding risk-taking activities. We anticipate that the customer's risk preference (proxied by the CEO's risk tolerance) plays a key role in shaping suppliers' investment strategies in general and, specifically, that customer CEOs who exhibit a high level of risk tolerance exacerbate suppliers' investment inefficiency. In terms of risk tolerance, an individual's inherent personal attribute is incremental over incentive and monitoring structure because such innate personality traits shape the utility function without being severely constrained by monitoring mechanisms or incentive compensations.

Within the psychology literature, the desire to fly an airplane is strongly associated with thrill- and adventure-seeking (Zuckerman 1971; Zuckerman et al. 1978). CEOs with piloting experience are often viewed as sensation seekers who prefer activities that heighten their stimulation. Such stimulation includes thrill- and adventure-seeking, which can also be experienced in outdoor sports or recreational activities involving speed, danger, novelty, and defiance of gravity (Zuckerman 1971). Cain and McKeon (2016) document the fatality rates associated with common forms of transportation, such as motorcycles, hot-air balloons, helicopters, passenger cars, and commercial airlines. Their findings reveal that the fatality rate for personal/business flying ranks significantly higher than those for other forms of transportation. Cain and McKeon (2016) conclude that operating small aircraft demonstrates risk-taking behavior and that the pilot licensing status of CEOs is therefore an effective proxy for managerial risk preferences. The findings of this empirical study reveal that firms with pilot CEOs are associated with higher risk taking, whereby elevated firm risk arises from the higher leverage and increased acquisition activities undertaken by the CEOs. Further, Sunder et al. (2017) show that firms with pilot CEOs are likely to be more successful than those with non-pilot CEOs in developing innovations in what is known to be a risky, unpredictable, and long-term process.

2.3. Hypothesis Development

In light of the findings of the above-mentioned studies, we use CEO pilot licensing status to examine the implications of the risk tolerance of customer CEOs for suppliers' investment decisions. Specifically, we postulate that high risk tolerance of a customer CEO prompts the supplier's investment inefficiency where the supplier is unable to correctly interpret information from the customer. We propose and test the following hypothesis, stated in null form:

Hypothesis 1 (H1). *There is no association between customers' risk tolerance and suppliers' investment inefficiency.*

Note that our hypothesis assumes that suppliers do not have information about the risk tolerance of customers' CEOs. However, if suppliers could infer the level of risk tolerance of the customer CEO based on whether or not the concerned CEO holds a valid pilot license, then we would observe no impact and fail to reject the null hypothesis.

Investment inefficiency comprises both underinvestment and overinvestment. Thus, we posit that the supplier will either underinvest or overinvest, depending on their expectations regarding their customers' ability to fulfill or renege on their purchasing contracts. When suppliers make ex ante investments to enhance their production capacity and R&D, they rely mainly on implicit and informal contracts rather than on legally binding, explicit contracts with their customers. Previous studies on suppliers' relationship-specific investments provide mixed evidence regarding the directions of their investment inefficiency. On the one hand, suppliers who face a "hold-up" dilemma tend to underinvest because of their expectations that customers are likely to renege on implicit contracts and extract ex post quasi-rent (e.g., Baiman et al. 2001). On the other hand, suppliers inevitably build upwards production capacity from the amplified demand information from their customers, and such 'boost-up' problems could lead to overinvestment by suppliers (e.g., Kouvelis et al. 2006).[2] Therefore, we examine the investment inefficiency of suppliers from both perspectives: underinvestment and overinvestment. We postulate that if suppliers perceive the risk tolerance of the customer CEOs to be relatively high, they will be more likely to underinvest or overinvest. Hence, H1 can be decomposed into two parts:

Hypothesis 2a (H2a). *There is no association between customers' risk tolerance and suppliers' underinvestment.*

Hypothesis 2b (H2b). *There is no association between customers' risk tolerance and suppliers' overinvestment.*

To provide further evidence on the association between customers' risk tolerance and suppliers' investment inefficiency, we follow Chiu et al. (2019) and investigate whether the association is stronger when suppliers have less bargaining power. Our reasons are as follows. First, small suppliers with weak bargaining power are less able to bear the costs of overinvestment because of financing and liquidity constraints. Therefore, when faced with risk-tolerant customers (firms led by pilot CEOs) we expect that smaller suppliers would be more likely to be adversely impacted by such customers' overinvestments as well as by their own over-projections of future demands, leading to a greater likelihood of underinvestments by such suppliers. Second, for customers operating in a product market with higher fluidity (i.e., a more competitive product market), suppliers are more likely to remain with their existing major customers in a situation entailing more potential customers. Under these circumstances, we expect the investment inefficiency of such suppliers to be exacerbated as they may have to make more relationship-specific investments tailored to existing major customers to retain them.

3. Methodology and Data

3.1. Measurement of Customer Risk Tolerance

We use the pilot licensing status of customer CEOs as a proxy for customers' risk tolerance characteristic. The procedure that we use to identify CEOs is in line with that described by Cain and McKeon (2016) and Sunder et al. (2017). The pilot-related information is sourced from the Federal Aviation Administration (FAA) Airmen Certification database. We manually validate and cross-check FAA data by searching through the names of every CEO and supplementing information about a CEO's birthday and home address from Bloomberg, LexisNexis, and other public records. A CEO is classified as a non-pilot if his/her name is not listed on the FAA website or if it matches a name in the database, but this individual has not passed the validation process.

3.2. Identification of Major Customers

Emulating previous studies (Banerjee et al. 2008; Chiu et al. 2019; Chen et al. 2019), major customers for a supplier are identified as those accounting for more than 10 percent of their sales (COMPUSTAT. SFAS Nos. 14 and 131). Following Chiu et al. (2019), we obtain the names of major customer firms from the COMPUSTAT industry segment customer file and manually match them with their corresponding COMPUSTAT identifiers (GVKEY). The suppliers' investments are likely to be relationship-specific because customers who account for over 10 percent of the suppliers' total sales, have strong bargaining power over the suppliers when determining their capacities. Consequently, suppliers who must invest in relationship-specific assets to tailor for the demand are more likely to be affected (Banerjee et al. 2008).

3.3. Model Specification

We construct the investment inefficiency variable using the method described by Biddle et al. (2009) and Chiu et al. (2019). We first measure a firm's deviation from the expected investment and subsequently apply the following equation, using the residuals to identify underinvestment and overinvestment:

$$Invest_{t+1} = \alpha_0 + \alpha_1 Sgrowth_t + \varepsilon_{t+1} \quad (1)$$

where $Invest_{t+1}$ is the total investment at year t + 1, which is the total of R&D expenses (RD), capital and acquisition expenditure, minus cash receipts from sales of properties, plants, and equipment (PPE), and depreciation and amortization in year t + 1, scaled by lagged total assets and multiplied by 100. The missing R&D expenditure values are substituted by their yearly industry average measured by the four-digit Standard Industrial Classification (SIC) system.[3] $Sgrowth_t$ denotes percentage changes in sales from year $t - 1$ to t. Following Biddle et al. (2009), we conduct an estimation using Equation (1) for all 48 Fama and French classifications for industries by year and industry. The investment efficiency is defined as a categorical variable, R_invest_{t+1}, denoting the quartiles based on the residuals from Equation (1). Specifically, R_invest_{t+1} values are set as follows: 1 for firm-years in the bottom quartile with the most negative residuals (the underinvesting group), 2 for firm-years with residuals located in the middle two quartiles (the benchmark group), and 3 for firm-years in the top quartile (the overinvesting group) with the most positive residuals.

Next, we construct the main model as a multinomial logistic model expressed by Equation (2). All of the continuous variables are winsorized at 1% and 99%. For the control variables, we include characteristics from both the supplier and customer sides.

$$R\_investt + 1 = \beta 0 + \beta 1Pilott + \beta i,tSupplierControlsi,t + \beta j,tCustomerControlsj,t + \varepsilon t + 1 \quad (2)$$

Adopting the approach suggested by Biddle et al. (2009), we include a set of financial and governance variables to control for the effects of a supplier's characteristics on its own investment inefficiency. The controls for suppliers included institutional ownership (IO_S), number of analysts following a firm (NUMEST), cash flow, sales, and investment volatility (CFOSD, SALESD, and INVESTSD), Altman's Z-score (ZSCORE), total assets (TA_S), book-to-market ratio (BM_S), loss (LOSS_S), leverage (LEV_S), industry leverage (LEV_IND), operating cash flows relative to sales (CFOSALE), operating cycle (OPCYCLE), firm age (AGE), cash slack relative to PPE (SLACK), and dividend payout (DIV). The Appendix A provides definitions for all of the variables.[4]

We also control for corporate and financial firm-specific variables for customers. We include customers' financial characteristics, namely, their total assets (TA_C), loss (LOSS_C), leverage (LEV_C), book-to-market ratio (BM_C), the one-year stock return (Ret), the standard deviation of daily stock returns over the fiscal year (Ret_Volat), and the duration of the customer–supplier relationship (CS_length). Furthermore, following Lee et al. (2017) and Hrazdil et al. (2020), we include Delta and Vega to control for CEOs' risk-taking incentives. The key variable of interest is Pilot and all the controls from the customer side are measured on the basis of the sales-weighted average of all of the major customers for a certain supplier. Detailed definitions of these variables are provided in the Appendix A.

3.4. Sample

Our initial data sample comprises all firm-year observations included in Compustat during the period 1999–2017. Our data sources are as follows: Compustat for the firm characteristics, CRSP for stock return data, IBES for analyst following, ExecuComp for CEO compensation, and Thomas Reuters for institutional ownership data. After these data are merged with the data on CEOs' pilot licensing status, the final sample comprises 9928 supplier–customer-years, covering 1375 unique suppliers and 524 unique customers between 2000 and 2016.[5] Because each unique supplier has one or more customers, if the original sample includes suppliers with more customers, the data could be redundant, and the empirical results could be distorted. Therefore, we condense the sample according to unique supplier-years. Following Chiu et al. (2019), we obtain a weighted average of all customer-side variables, where we define the weight as a supplier's sales to a major customer divided by the supplier's total sales to all disclosed major customers. The final sample comprises 6034 supplier-year observations, with all the customer-side variables in Equation (2) replaced by the sales-weighted averages. Table 1 depicts the yearly distribution of the sample.

Table 1. Year-wise sample distribution.

Fiscal Year	Frequency	Percent	Cumulative
2000	102	1.69	1.69
2001	136	2.25	3.94
2002	189	3.13	7.08
2003	368	6.10	13.18
2004	439	7.28	20.45
2005	489	8.10	28.55
2006	472	7.82	36.38
2007	491	8.14	44.51
2008	427	7.08	51.59
2009	430	7.13	58.72
2010	415	6.88	65.59
2011	377	6.25	71.84
2012	379	6.28	78.12
2013	347	5.75	83.87
2014	328	5.44	89.31
2015	326	5.40	94.71
2016	319	5.29	100.00
Total	6034	100.000	

4. Results

4.1. Descriptive Statistics

Table 2 presents the descriptive statistics of the variables used in the main regression and partitions variables related to Pilot for the three investment groups (underinvestment, normal investment, and overinvestment). The mean and median values of R_invest are 2.023 and 2.000, respectively, suggesting that the supplier's investment efficiency is close to the normal level (R_invest = 2). The percentage of pilot CEOs is higher in both the underinvestment (1.70%) and overinvestment (1.20%) groups relative to the normal investment (0.70%) group.

Table 2. Summary statistics.

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Median	Maximum
R_invest	6034	2.023	0.795	1.000	2.000	3.000
Pilot	6034	0.012	0.059	0.000	0.000	0.910
TA_S	6034	6.278	1.925	0.440	6.218	11.670
BM_S	6034	0.647	0.301	0.031	0.624	2.186
CFOSD	6034	0.120	0.533	0.002	0.059	12.393
AGE	6034	2.635	0.828	0.693	2.708	3.932
INVESTSD	6034	13.508	28.572	0.008	6.617	427.423
SALESD	6034	0.294	0.410	0.002	0.186	5.769
ZSCORE	6034	4.272	7.842	−158.28	3.319	113.115
LEV_S	6034	0.305	0.211	0.005	0.265	0.980
CFOSALE	6034	−0.148	2.473	−45.250	0.087	0.985
SLACK	6034	6.162	18.731	0.000	1.214	204.667
DIV	6034	0.307	0.461	0.000	0.000	1.000
LOSS	6034	0.340	0.474	0.000	0.000	1.000
OPCYCLE	6034	4.687	0.688	1.679	4.727	8.800
LEV_IND	6034	0.336	0.099	0.145	0.323	0.876
IO_S	6034	0.543	0.359	0.000	0.620	2.050
NUMEST	6034	7.275	7.368	0.000	5.000	45.000
Ret	6034	0.004	0.090	−0.834	−0.002	3.692
Ret_Volat	6034	0.004	0.005	0.000	0.003	0.229
TA_C	6034	2.584	2.455	0.000	1.950	105.049
LEV_C	6034	0.100	0.145	0.000	0.070	8.249
LOSS_C	6034	0.021	0.143	0.000	0.000	9.002
Delta	6034	1.569	1.448	0.000	1.184	54.079
Vega	6034	1.258	1.378	−2.226	0.944	57.865
CS_length	6034	0.912	1.222	0.000	0.499	15.908
Underinvestment	1838	0.017	0.072	0.000	0.000	0.758
Normal investment	2220	0.007	0.037	0.000	0.000	0.370
Overinvestment	1976	0.012	0.064	0.000	0.000	0.763

All of the variables are defined in the Appendix A.

The above results endorse a view that suppliers tend to either underinvest or overinvest when the percentage of customers that have pilot CEOs is higher, which provides first empirical support for H1. Table 2 further reveals that on average 1.2% of sales are generated from customers that have a pilot license, while existing research on pilot licenses (e.g., Cain and McKeon 2016; Sunder et al. 2017) documents that 6% to 9% of managers have a pilot license. This is because existing studies (Cain and McKeon 2016; Sunder et al. 2017) only focus on firm-wise analysis, so the variable "Pilot" is an indicator variable with value of zero or one. However, we investigate the interaction among firms along the supply chain, and the variable "Pilot" is a weighted-average variable with values varying from 0 to 1 in our sample. In other words, a supplier's sales could be generated between 0% to 100% from customers with pilot CEOs.

4.2. Main Results

Table 3 shows the main results that reveal how pilot CEOs in customer firms affect their suppliers' investment efficiency. The estimation in Equation (2) is conducted using a multinomial logistic regression to predict the likelihood of a firm belonging to an underinvesting (R_invest = 1) or overinvesting (R_invest = 3) group, measured against the benchmark group with normal investment levels (R_invest = 2). Columns (1)–(3) in this table present the results for underinvestment, while columns (4)–(6) present the results for overinvestment. In columns (1) and (4), we only include supplier-side controls, whereas in columns (2) and (5), we only control for the customer side. Columns (3) and (6) depict the results that control for both supplier and customer variables.

Table 3. Main regression results.

Variable	Underinvestment vs. Normal Investment			Overinvestment vs. Normal Investment		
	(1)	(2)	(3)	(4)	(5)	(6)
Pilot	2.607 ***	2.736 ***	2.336 ***	1.425 *	1.876 **	1.418 *
	(0.000)	(0.000)	(0.003)	(0.061)	(0.011)	(0.074)
TA_S	−0.073		−0.066	−0.121 ***		−0.122 ***
	(0.155)		(0.194)	(0.002)		(0.002)
BM_S	0.693 ***		0.697 ***	−0.778 ***		−0.776 ***
	(0.000)		(0.001)	(0.000)		(0.000)
CFOSD	−0.143		−0.143	−0.295 **		−0.302 **
	(0.313)		(0.305)	(0.030)		(0.027)
AGE	−0.126 **		−0.155 **	−0.198 ***		−0.208 ***
	(0.050)		(0.017)	(0.001)		(0.000)
INVESTSD	0.009 ***		0.009 ***	0.013 ***		0.013 ***
	(0.005)		(0.007)	(0.000)		(0.000)
SALESD	−0.354 ***		−0.332 ***	−0.355 ***		−0.346 ***
	(0.006)		(0.008)	(0.008)		(0.007)
ZSCORE	−0.001		0.000	−0.032 ***		−0.032 ***
	(0.945)		(0.953)	(0.000)		(0.000)
LEV_S	−0.182		−0.217	−1.169 ***		−1.184 ***
	(0.593)		(0.527)	(0.000)		(0.000)
CFOSALE	−0.037 **		−0.047 ***	−0.030 *		−0.031 *
	(0.010)		(0.004)	(0.079)		(0.097)
SLACK	0.008 **		0.008 **	−0.002		−0.003
	(0.015)		(0.021)	(0.453)		(0.386)
DIV	−0.115		−0.113	−0.300 ***		−0.295 ***
	(0.358)		(0.366)	(0.003)		(0.003)
LOSS_S	−0.0529		−0.031	0.194 **		0.208 **
	(0.573)		(0.739)	(0.023)		(0.015)
OPCYCLE	0.045		0.024	−0.0176		−0.010
	(0.548)		(0.746)	(0.785)		(0.880)
LEV_IND	−5.985 ***		−6.080 ***	−0.298		−0.268
	(0.000)		(0.000)	(0.527)		(0.579)
IO_S	−0.042		−0.045	0.346 ***		0.344 ***
	(0.766)		(0.747)	(0.006)		(0.006)
NUMEST	0.019 *		0.015	0.021 **		0.020 **
	(0.093)		(0.179)	(0.018)		(0.021)
Ret		−0.010	−0.127		0.372	0.413
		(0.981)	(0.772)		(0.345)	(0.323)
Ret_Volat		−24.170	−6.899		−12.550	−8.719
		(0.140)	(0.685)		(0.454)	(0.632)
TA_C		−0.188 **	−0.244 ***		0.002	−0.0241
		(0.016)	(0.001)		(0.972)	(0.694)
BM_C		3.341 ***	2.375 *		1.775	0.336
		(0.005)	(0.052)		(0.118)	(0.759)
LEV_C		−1.709	0.185		−1.345	0.593
		(0.157)	(0.881)		(0.280)	(0.624)
LOSS_C		−0.386	−0.399		−0.421	−0.524
		(0.407)	(0.421)		(0.367)	(0.298)
Delta		0.331 ***	0.206 **		0.202 **	0.109
		(0.001)	(0.047)		(0.038)	(0.246)
Vega		−0.033	−0.045		−0.153 **	−0.126 *
		(0.681)	(0.584)		(0.038)	(0.092)
CS_length		0.037	0.139 ***		−0.075 *	0.037
		(0.432)	(0.004)		(0.098)	(0.448)
Constant	1.859 ***	−0.486 ***	1.934 ***	2.016 ***	−0.271 ***	1.950 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	6034	6034	6034	6034	6034	6034
Pseudo R^2	0.009	0.009	0.009	0.073	0.073	0.073

All of the variables are defined in the Appendix A. *p*-values in parentheses are calculated based on the Z-statistics using robust standard errors clustered by firm. The superscripts *, **, and *** denote significance levels of 0.10, 0.05, and 0.01, respectively, based on a two-tailed test.

In columns (1)–(3), where the dependent variable is the likelihood of suppliers' underinvestments relative to normal investments, the coefficients of Pilot is positive and significant in all three columns (2.607, 2.736, and 2.336 with *p*-values of 0.000, 0.000, 0.003, respectively). These significantly positive associations between customer CEOs who are pilots and suppliers' underinvestments suggest that suppliers tend to engage more in underinvestment relative to normal investment when customer CEOs are more risk-tolerant, as reflected in their pilot licensing status (supporting the alternative form of H2a).

In columns (4)–(6), the dependent variable captures the likelihood of suppliers making overinvestments relative to normal investments. The coefficients of Pilot are also positive and significant in all three columns (1.452, 1.876, and 1.418, respectively, with p-values below 0.100). These significantly positive associations between the pilot CEOs of customer firms and suppliers' overinvestments reveal a tendency among suppliers to overinvest relative to normal investing when customer CEOs were risk-tolerant (supporting the alternative form of H2b). Overall, the results depicted in Table 3 suggest that the suppliers' responses to risk-tolerant pilot CEOs are symmetric; that is, suppliers tend to underinvest or overinvest when dealing with customer firms run by pilot CEOs. On the one hand, suppliers have less ex ante incentives to invest when dealing with risk-tolerant customer firms run by pilot CEOs because they want to avoid the "locked-in" effect of investing in relationship-specific assets. On the other hand, suppliers are also likely to overinvest because of the potential amplified demands of risk-seeking customer firms with pilot CEOs. Therefore, suppliers' investments tend to demonstrate more fluctuations when their customer firms are headed by pilot CEOs.

As for the control variables on the supplier side, the coefficients of BM_S are significantly positive in columns (1) and (3) of Table 3, and significantly negative in columns (4) and (6), indicating a tendency among firms to underinvest when the supplier is undervalued. The coefficients of INVESTSD in columns (1), (3), (4), and (6) are significantly positive, suggesting that as the supplier experiences more investment volatility, the firm is less likely to achieve investment efficiency. The coefficients of Age shown in columns (1), (3), (4), and (6) are significantly negative, suggesting that as suppliers acquire experience, their investments become correspondingly more efficient. Finally, the coefficients of CFOSALE are all significantly negative in columns (1), (3), (4), and (6), indicating that suppliers with greater operating cash flows tend to demonstrate higher levels of investment efficiency.

Overall, the results reported in Table 3 support the hypothesis that customers' risk tolerance is negatively associated with the likelihood of suppliers' investment efficiency. In other words, customers' risk tolerance is positively associated with suppliers' investment inefficiency, whether this manifests as underinvestment or overinvestment.

4.3. Cross-Sectional Analyses

In our cross-sectional tests, we follow the approach of Chiu et al. (2019) and investigate the supplier–customer relationship from three perspectives relating to relative bargaining power. In the first cross-sectional analysis, we use the relative size of the supplier to proxy for the relative bargaining power between suppliers and customers. In the second analysis, we investigate how the supplier's underinvestment varies with the customer's product market fluidity.

In the first analysis, following Hui et al. (2012) and Chiu et al. (2019), we use the average market value of firms in each customer's industry relative to the market value of the supplier firm to measure suppliers' sizes relative to their customers. Similar to the method used to define control variables for customers, we also weight the major customers' market values by dividing the individual supplier's sales to a specific major customer by the supplier's total sales to all disclosed major customers. We classify the supplier as a large supplier, if the ratio is above the median value in each fiscal year. Next, we partition the sample into large and small suppliers and conduct multinomial logistic regressions, as shown in Equation (2), for each subsample.

Table 4 depicts the results obtained for subsamples of suppliers grouped according to relative size. Of the 6034 supplier-years, there are 2998 large suppliers and 3006 small suppliers.

Table 4. Cross-sectional analyses: Relative size of suppliers.

	Under- vs. Normal Investments		Over- vs. Normal Investments	
Variable	**Large Suppliers**	**Small Suppliers**	**Large Suppliers**	**Small Suppliers**
	(1)	**(2)**	**(3)**	**(4)**
Pilot	−0.324	3.667 ***	−1.837	3.030 ***
	(0.763)	(0.000)	(0.146)	(0.001)
p-values for differences	0.015		0.005	
Controls	Yes	Yes	Yes	Yes
N	2998	3006	2998	3006
Pseudo R^2	0.086	0.082	0.086	0.082

All of the variables are defined in the Appendix A. *p*-values in parentheses are calculated based on the Z-statistics, using robust standard errors clustered by firm. The superscript *** denotes significance level of 0.01, based on a two-tailed test.

The coefficient of Pilot for both the underinvestment and overinvestment groups of small suppliers shown in columns (2) and (4), respectively, are significantly positive (3.667 and 3.030, respectively, with significance level at or below 0.01%). By comparison, the coefficients of Pilot for large suppliers shown in columns (1) and (3) are both insignificant. Furthermore, the difference in coefficients between the two subsamples of large and small suppliers is statistically significant at 1.5% and 0.5% percent level for underinvestment and overinvestment tests, respectively, indicating that the pilot status of customer CEOs has significantly differential effects on large and small suppliers. This result lends further support to our hypothesis, suggesting that the investment inefficiency of small suppliers is more pronounced compared with that of large suppliers because small suppliers have less bargaining power relative to their customers.

In the second analysis, we examine the effect of relative bargaining power of suppliers, as product market competition among industry peers also determines the suppliers' bargaining power when dealing with customers (Hui et al. 2012; Fabbri and Klapper 2016). Previous studies have assessed the impacts of product market competition of a firm's own industry (Bamber and Cheon 1998; Harris 1998; Verrecchia and Weber 2006). However, Fabbri and Klapper (2016) show that the relative bargaining power between suppliers and customers based on industry-level measures is related to market fluidity from the customer side. Accordingly, considering customers' industry-level market competition, we focus on the relative bargaining power of suppliers. Our expectation is that suppliers have less bargaining power when faced with customers in less competitive industries, because such suppliers have limited alternatives to sell oversupplied goods and services once their customers renege.

We follow Fabbri and Klapper (2016) and use the Herfindahl–Hirschman Index (HHI) to proxy for market competition. According to the commonly held view, HHI is a measure of industry concentration and hence can be viewed as an inverse measure of product market competition. In other words, lower HHI indicates higher market competition. In addition to constructing customer-side control variables, we use the sales-weighted average fluidity score of a particular supplier's major customers. We estimate multinomial logistic regressions in Equation (2) separately for high and low market competition groups based on the median value of the customers' HHI index. Referring to the literature, we construct weighted averages for customers' HHI index based on weights calculated as a supplier's sales to a major customer divided by the total sales. Table 5 depicts the results of the cross-sectional analysis relating to the customer market competition.

Table 5. Cross-sectional analyses: Customer competition.

Variable	Under- vs. Normal Investments		Over- vs. Normal Investments	
	High Competition	Low Competition	High Competition	Low Competition
	(1)	(2)	(3)	(4)
Pilot	0.780	2.219 **	−0.091	1.708 **
	(0.468)	(0.011)	(0.485)	(0.047)
p-values for differences	0.339		0.073	
Controls	Yes	Yes	Yes	Yes
N	3084	2950	3084	2950
Pseudo R^2	0.094	0.073	0.094	0.073

All of the variables are defined in the Appendix A. The relative bargaining power of suppliers derived from customer market competition is based on Fama–French 48 industries. *p*-values in parentheses are calculated based on the Z-statistics, using robust standard errors clustered by firm. The superscript ** denotes significance level of 0.05, based on a two-tailed test.

The coefficients of Pilot for both underinvestment and overinvestment are significantly positive for the low competition group (2.219 with a *p*-value of 0.011 and 1.708, with a *p*-value of 0.047, respectively). By contrast, the coefficients of Pilot for the high competition group are insignificant. However, the differences in the coefficients between the high and low competition groups are statistically insignificant for underinvestment test, but significant at the 10% significance level for overinvestment test, suggesting that supplier overinvestment is more pronounced when faced with more concentrated customers.

4.4. Robustness Tests

As the first robustness check, we follow Chen et al. (2019) and apply the OLS regression in lieu of the multinomial regression to investigate whether an association exists between suppliers' investment efficiency and the customer CEO's pilot status. We construct the dependent variable Inefficiency based on R_invest, where Inefficiency takes the value of one when R_invest is one (underinvestment) or three (overinvestment), and the value of zero when R_invest is zero (normal investment). This definition indicates the investment inefficiency without revealing its direction (underinvestment or overinvestment). All the control variables follow Equation (2), except that we control for supplier firm fixed effects and year-based fixed effects[6] and cluster standard errors by industry, based on the Fama–French 48-industry classification.

As the second robustness check, we apply an alternative proxy for risk tolerance based on the amount of vested in-the-money options held by a CEO. As executives' fortunes are based on their firms' performance (both in terms of human capital and financial wealth), rational CEOs will exercise their exercisable in-the-money options as early as possible to diversify their wealth, unless they are overconfident about their ability to predict their firms' future returns (Malmendier and Tate 2005; Kim et al. 2016; Lee et al. 2017). The degree to which executives exercise their in-the-money options reflects their risk aversion levels, where more vested in-the money options held by a CEO correspond to greater risk taking (Hrazdil et al. 2020). We define CEO overconfidence (Overconf) as the ratio of a given CEO's vested in-the-money option value to the total compensation value (Hribar and Yang 2016; Kim et al. 2016) and include the overconfidence measure of customer CEO in the multinomial logistic regression expressed in Equation (2). Table 6 shows the estimation results of separate OLS regressions for Pilot and Overconf as explanatory variables in columns (1) and (2), respectively. We include both Pilot and Overconf in column (3).

Table 6. Robustness tests: OLS regressions.

Variable	(1)	(2)	(3)
Pilot	0.300 **		0.264 *
	(0.030)		(0.055)
Overconf		0.068 *	0.055
		(0.055)	(0.124)
Supplier Controls	Yes	No	Yes
Customer Controls	No	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Clustered by industry	Yes	Yes	Yes
N	6034	6034	6034
Adjusted R^2	0.186	0.186	0.186

All variables are defined in the Appendix A. A value of 1 is assigned to inefficiency for R_invest values of 1 or 3; otherwise, the value of inefficiency is 0. *p*-values in parentheses are calculated based on the Z-statistics using robust standard errors clustered by firm. The superscripts *, and ** denote significance levels of 0.10, and 0.05, respectively, based on a two-tailed test.

The results shown in Table 6 are consistent with the main model based on multinomial logistic regression. The coefficient of Pilot in column (1) is positive and significant at the 5% level, suggesting that suppliers tend to underinvest when faced with customer firms headed by pilot CEOs. The coefficient of Overconf in column (2) is also positive and significant at the 10% level. However, when both proxies for risk tolerance are included in column (3), the coefficient of Pilot remains significant (at the 10% level) while that of Overconf becomes insignificant. In short, the OLS regression results in Table 6, taken together, reconfirm that customer CEOs' risk tolerance leads to suppliers' investment inefficiency, even after controlling for CEOs' overconfidence.

Table 7 presents the estimation results when Overconf is included in our main models (Equation (2)). We include Pilot and Overconf variables in the multinomial logistic regression, as in columns (3) and (6), jointly, and individually (in all of the other columns).

Table 7. Robustness tests: Multinomial logistic regressions.

Variable	Underinvestment vs. Normal Investment			Overinvestment vs. Normal Investment		
	(1)	(2)	(3)	(4)	(5)	(6)
Pilot	2.366 ***		2.113 ***	1.411 *		1.228
	(0.002)		(0.009)	(0.075)		(0.141)
Overconf		0.920 ***	0.857 ***		0.774 ***	0.755 ***
		(0.000)	(0.000)		(0.000)	(0.001)
Supplier Controls	Yes	Yes	Yes	Yes	Yes	Yes
Customer Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	6034	6034	6034	6034	6034	6034
Pseudo R^2	0.071	0.072	0.073	0.071	0.072	0.073

All variables are defined in the Appendix A. *p*-values in parentheses are calculated based on the Z-statistics using robust standard errors clustered by firm. The superscripts * and *** denote significance levels of 0.10 and 0.01, respectively, based on a two-tailed test.

The results in Table 7 are similar to those shown in Table 6; when Pilot and Overconf are included separately, both were positive and individually significant as shown in columns (1), (2), (4), and (5). In sharp contrast, when both are included together, as in columns (3) and (6), both proxies for risk tolerance are predominant in the explanation of underinvestment depicted in column (3), whereas Overconf is predominant in the explanation of overinvestment shown in column (6).[7] Overall, the findings of our sensitivity tests are in line with our main results reported in Table 4, indicating that through its effect in reducing suppliers' ex ante incentives to invest, customer risk tolerance is negatively (positively) associated with suppliers' investment efficiency (inefficiency).

4.5. Endogeneity Concerns: Pilot CEO Turnover

In order to address endogeneity concerns, we investigate the causal relation between customer CEO risk tolerance and supplier investment efficiency by examining firms that experienced a change in pilot status of the CEOs (i.e., switching from a non-pilot CEO to a pilot CEO, or vice versa) during our sample period. Specifically, our analysis focuses on the dynamics of the pilot CEO turnover over multiple periods. Following Bertrand and Mullainathan (2003) and Fauver et al. (2017), we replace the single Pilot dummy with three sets of dummy variables to track the effect of the year "before", "at", and "after" the changes in the customer pilot status. Specifically, $toPilot_{t-1}$ ($nonPilot_{t-1}$) equals one for the year before the customer CEO switches from non-pilot to pilot (pilot to non-pilot), and zero otherwise; $toPilot_t$ ($nonPilot_t$) equals one for the year that the customer CEO switches from non-pilot to pilot (pilot to non-pilot), and zero otherwise; and to $Pilot_{t+1}$ ($nonPilot_{t+1}$) equals one for the year after the customer CEO switches from non-pilot to pilot (pilot to non-pilot), and zero otherwise. We also create a set of categorical variables $sumPilot_{t-1}$, $sumPilot_t$, and $sumPilot_{t+1}$ to capture the combined effect of changes in the pilot status of customer CEOs. Specifically, sumPilott − 1 ($sumPilot_t$, $sumPilot_{t+1}$) equals 1 for the year before (at, and after) the customer CEO switches from non-pilot to pilot; −1 for the year before (at; after) the customer CEO switches from pilot to non-pilot, and zero otherwise. We conduct the same set of multinomial logistic regressions following the main analysis. Table 8 presents the underinvestment vs. normal investment tests in column (1) to (3), and overinvestment vs. normal investment tests in column (4) to (6).

Table 8. Endogeneity concerns: Pilot turnover.

Variable	**Underinvestment vs. Normal Investment**			**Overinvestment vs. Normal Investment**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$toPilot_{t-1}$	−0.233			−0.931		
	(0.868)			(0.481)		
$toPilot_t$	−3.284			−0.836		
	(0.173)			(0.771)		
$toPilot_{t+1}$	3.150 *			−0.230		
	(0.063)			(0.904)		
$nonPilot_{t-1}$		0.906			1.819	
		(0.588)			(0.233)	
$nonPilot_t$	−3.754 **			−0.924		
		(0.041)			(0.540)	
$nonPilot_{t+1}$		−0.865			−1.374	
		(0.554)			(0.430)	
$sumPilot_{t-1}$			−0.357			−1.324
			(0.727)			(0.183)
$sumPilot_t$		0.811			0.378	
			(0.510)			(0.806)
$sumPilot_{t+1}$		2.231 *			0.754	
			(0.082)			(0.502)
Supplier controls	Yes	Yes	Yes	Yes	Yes	Yes
Customer controls	Yes	Yes	Yes	Yes	Yes	Yes
N	6034	6034	6034	6034	6034	6034
Pseudo R^2	0.074	0.074	0.074	0.074	0.074	0.074

All of the variables are defined in the Appendix A. *p*-values in parentheses are calculated based on the Z-statistics using robust standard errors clustered by firm. The superscripts *and ** denote significance levels of 0.10 and 0.05, respectively, based on a two-tailed test.

The coefficients of $toPilot_{t-1}$, $nonPilot_{t-1}$, and $sumPilot_{t-1}$ are insignificant for both underinvestment overinvestment analyses, whereas the coefficients of $toPilot_{t+1}$ and $sumPilot_{t+1}$ are positive and significant for the underinvestment analysis, whereas the coefficient of $nonPilot_t$ is significantly negative. However, the overinvestment tests lack significance in the turnover setting. These results provide at least partial evidence that the changes in the pilot status of CEOs in customer firms lead to supplier investment inefficiency. The results also suggest that suppliers have a higher likelihood to underinvest when faced with customer pilot CEOs.

5. Conclusions

We investigate whether suppliers' investment inefficiency is induced by risk-tolerant customers (headed by pilot CEOs). We use the pilot licensing status of CEOs in customer firms as a proxy for their relatively high levels of risk tolerance. In our empirical analysis, we partition the sample into underinvestment, normal, and overinvestment groups and conduct multinomial logistic regressions to examine the likelihood of suppliers' underinvestment or overinvestment. The results reveal that customer firms led by CEOs who are pilots are bi-directionally associated with suppliers' investment inefficiency (underinvestment and overinvestment). Moreover, the cross-sectional analyses reveal that this association is more pronounced when suppliers are relatively small with weak bargaining power relative to their major customers, or when suppliers are faced with customers in highly competitive markets.

Within the supply chain literature, various mechanisms whereby suppliers can assess their customers' ability to fulfill contracts ex post based on ex ante information provided by their customers have been explored. Our finding that the risk tolerance of CEOs in downstream firms (customers) induces volatility in the investment decisions of upstream firms (suppliers) adds to this literature. An important takeaway from our findings is that customers' ex ante risk tolerance levels have spillover effects along the supply chain, with suppliers' investment efficiency being negatively associated with customers' ex ante risk-tolerance levels. These findings suggest that the pilot status of customer CEOs serves as an indicator that could potentially help suppliers to predict more accurately the outcomes of their relationship-specific investments and hence make more informed investment decisions. For example, suppliers could anticipate the amplified demands of customers with pilot CEOs and adjust their investments accordingly. In sum, the pilot status of customer CEOs signals a higher level of risk tolerance. Consequently, when faced with customer firms led by pilot CEOs, suppliers anticipate more uncertainties in investment decisions, thereby exacerbating their investment inefficiency.

Our study faces limitations. For example, it is possible that customer pilot status only captures a small portion of the overall risk profile and thus risk faced by suppliers. Thus, our study does not claim that a firm's pilot status of a CEO fully reflects the full potential risk faced by its suppliers; although, we find that customer risk tolerance proxied by a pilot status of CEO significantly affects suppliers' investment inefficiency. Given the limited empirical evidence on the effect of customer risk tolerance on investment decisions of suppliers, we encourage future research to utilize different proxies for risk tolerance to test this association. We also encourage future research to employ the pilot status of CEO as a proxy for risk tolerance to further examine the role of personality on issues relevant to financial management. Understanding how the personality of managers affects their decision making is of interest to investors and other capital market participants who predict and evaluate corporate outcomes; shedding light on risk tolerance and the corporate policies associated with such trait will ultimately lead to better corporate decision making.

Author Contributions: Conceptualization, J.-B.K.; methodology, J.-B.K.; software, X.L.; validation, X.L.; formal analysis, X.L.; investigation, X.L.; resources, K.H.; data curation, X.L.; writing—original draft preparation, X.L.; writing—K.H.; visualization, K.H.; supervision, J.-B.K.; project administration, K.H.; funding acquisition, K.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Social Sciences and Humanities Research Council of Canada, grant number 31-R640084.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data are available from the corresponding author upon reasonable request.

Acknowledgments: We thank Rafael Rogo, Dan Simunic, Eric Werker, Ray Zhang, Dennis Chung, and Jamal Nazari for their helpful comments and suggestions.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Variable Definitions.

Variable	Definition
Inefficiency	An indicator variable used to indicate whether the supplier firm is located in either the underinvestment group or the overinvestment group based on the variable R_invest. Its value is 1 if the R_invest value is 1 or 3, and 0 if the R_invest value is 2.
Pilot	If a CEO has a pilot license, the indicator variable is 1; if the CEO has never held a pilot license, its value is 0. Pilot is then defined as the sales-weighted averages of the indicator variable Pilot of the major customers of each supplier, as we condense the major customer firms into one averaged customer for each supplier.
R_invest	A categorical variable based on the quartiles of the residuals from a firm-specific model of investment (Equation (1)). The variable is set to 1 for firm-years with residuals in the bottom quartile (underinvestment), 2 for firm-years with residuals in the middle two quartiles (normal investment), and 3 for firm-years with residuals in the top quartile (overinvestment).
Supplier controls	
AGE	The natural logarithm of the difference between the first year when the firm appears in Compustat and the current year.
BM_S	Total assets divided by the sum of the book value of debt and the market value of equity, where the book value of debt is computed as total assets minus the book value of equity.
CFOSALE	Cash flow from operations divided by sales.
CFOSD	The standard deviation of cash flow from operations deflated by lagged total assets over the past five years.
DIV	An indicator variable that equals 1 if the firm paid dividends; otherwise 0.
INVESTSD	The standard deviation of total investments scaled by lagged total assets over the past five years.
IO_S	The percentage of the firm's shares held by institutional investors. If no institutional ownership is reported in the Thomson-Reuters 13F database, then the value is set to 0.
LEV_IND	The industry average of leverage for firms in the same four-digit SIC industry group.
LEV_S	The leverage ratio, calculated as the long-term debt to the sum of long-term debt and the market value of equity.
LOSS_S	Equals 1 if income before extraordinary items is negative; otherwise 0.
NUMEST	The number of analysts following the firm. If no analyst coverage is reported in IBES for the firm, then the value is set to 0.

Table A1. *Cont.*

Variable	Definition
OPCYCLE	The natural logarithm of receivables to sales plus inventory to cost of goods sold multiplied by 360.
SALESD	The standard deviation of sales deflated by lagged total assets over the past five years.
SLACK	The ratio of cash to net PPE.
TA_S	The natural logarithm of total assets.
TAN_S	Asset tangibility, calculated as the ratio of net PPE to total assets.
ZSCORE	Altman's Z-score, computed as 1.2 × (working capital/total assets) + 1.4 × (retained earnings/total assets) + 3.3 × (earnings before interest and taxes/total assets) + 0.6 × (market value of equity/total liabilities) + 1.0 × (sales/total assets).
Customer controls	
BM_C	Total assets divided by the sum of the book value of debt and the market value of equity, where the book value of debt was computed as total assets minus the book value of equity.
CS_length	The duration of the customer–supplier relationship.
Delta	Natural log of dollar changes in CEO wealth for a 1% change in the stock price in year t.
LEV_C	The leverage ratio, calculated as the long-term debt to the sum of long-term debt and the market value of equity.
LOSS_C	Equals 1 if income before extraordinary items is negative; otherwise 0.
$nonPilot_{t-1}$	An indicator variable that equals 1 during the year before the customer CEO pilot status switches from pilot to non-pilot, and 0 otherwise.
$nonPilot_{t}$	An indicator variable that equals 1 if customer CEO pilot status switches from pilot to non-pilot in year t, and 0 otherwise.
$nonPilot_{t+1}$	An indicator variable that equals 1 during the year after the customer CEO pilot status switches from pilot to non-pilot, and 0 otherwise.
Overconf	Natural log of the ratio of a given CEO's vested in-the-money option value to the total compensation value in year t.
Ret	The sales-weighted average of the customers' daily abnormal stock returns.
Ret_Volat	The sales-weighted average of the customers' standard deviation of daily abnormal stock returns.
$sumPilot_{t-1}$	A categorical variable that equals 1 during the year before the customer CEO pilot status switches from non-pilot to pilot, -1 during the year before the customer CEO pilot status switches from pilot to non-pilot, and 0 otherwise.
$sumPilot_{t}$	A categorical variable that equals 1 if customer CEO pilot status switches from pilot to non-pilot in year t, −1 if customer CEO pilot status switches from non-pilot to pilot in year t, and 0 otherwise.
$sumPilot_{t+1}$	A categorical variable that equals 1 during the year after the customer CEO pilot status switches from non-pilot to pilot, −1 during the year after the customer CEO pilot status switches from pilot to non-pilot, and 0 otherwise.
TA_C	The natural logarithm of total assets.
$toPilot_{t-1}$	An indicator variable that equals 1 during the year before the customer CEO switches from non-pilot to pilot, and zero otherwise.
$toPilot_{t}$	An indicator variable that equals 1 if the customer CEO pilot status switches from non-pilot to pilot in year t, 0 otherwise.
$toPilot_{t+1}$	An indicator variable that equals 1 during the year after the customer CEO switches from non-pilot to pilot, and zero otherwise.
Vega	Natural logarithm of dollar changes in CEO wealth for a 1% change in the annualized standard deviation of stock returns.

Notes

1 Rather than a proxy for certain information disclosure of customer riskiness, the pilot status of CEO is used as a proxy for the uncertain CEO risk preferences. The pilot status of customer CEOs is not an informative disclosure, because it is neither a requirement from regulation nor a signal of informativeness of any direction.

2 In supply chain literature, the demand distortions that travel upstream in the supply chain from the customers through to the suppliers is sometimes called a 'bullwhip effect'. We examine whether the bullwhip effect is more pronounced when suppliers are faced with customers whose CEOs are pilots.

3 This procedure is meant to retain observations for the remaining analysis; our results are robust to not using this procedure.

4 All the customer-side variables in Equation (2) are replaced by the sales-weighted averages of the customer controls, because all the major customer controls are condensed into one line of observation for each supplier.

5 There are 524 unique customer companies with 34 pilot CEOs. Before sales-averages are calculated, pilot CEOs account for 5%; we have 467 pilot CEOs out of 9928 supplier–customer-years.

6 We can only control for the supplier firm fixed effect, as we use the sales-average values for all customer-side variables, so it is meaningless to control for customer firm fixed effect based on the final dataset. If we use the original dataset with all suppliers and major customers, the results would be biased towards suppliers with more major customers.

7 Our investigation of how the association between Overconf and inefficiency is affected by the relative sizes and bargaining power of suppliers, and suppliers' demand uncertainty revealed that although the coefficients on Overconf were higher for the large supplier, high competition, and high certainty categories, the differences between the groups are not statistically significant at conventional levels (results not tabulated).

References

Baiman, Stanley, Paul Fisher, and Madhav Rajan. 2001. Performance measurement and design in supply chains. *Management Science* 47: 173–88. [CrossRef]

Bamber, Linda S., and Youngsoon S. Cheon. 1998. Discretionary management earnings forecast disclosures: Antecedents and outcomes associated with forecast venue and forecast specificity choices. *Journal of Accounting Research* 36: 167–90. [CrossRef]

Banerjee, Shantanu, Sudipto Dasgupta, and Yungsan Kim. 2008. Buyer–supplier relationships and the stakeholder theory of capital structure. *Journal of Finance* 63: 2507–52. [CrossRef]

Bertrand, Marianne, and Sendhil Mullainathan. 2003. Enjoying the quiet life? Corporate governance and managerial preferences. *Journal of Political Economy* 111: 1043–75. [CrossRef]

Biddle, Gary C., Gilles Hilary, and Rodrigo S. Verdi. 2009. How does financial reporting quality relate to investment efficiency? *Journal of Accounting & Economics* 48: 112–31. [CrossRef]

Brown, Stephen, Yan Lu, Sugata Ray, and Song W. Teo. 2018. Sensation seeking and hedge funds. *Journal of Finance* 73: 2871–914. [CrossRef]

Cachon, Gérard P., and Christian Terwiesch. 2012. *Matching Supply with Demand: An Introduction to Operations Management*, 3rd ed. New York: McGraw-Hill Education.

Cachon, Gérard P., and Martin A. Lariviere. 2001. Contracting to assure supply: How to share demand forecasts in a supply chain. *Management Science* 47: 629–46. [CrossRef]

Cain, Matthew D., and Stephen B. McKeon. 2016. CEO personal risk-taking and corporate policies. *Journal of Financial and Quantitative Analysis* 51: 139–64. [CrossRef]

Chatfield, Dean C., Jeon G. Kim, Terry P. Harrison, and Jack C. Hayya. 2004. The bullwhip effect—Impact of stochastic lead time, information quality, and information sharing: A simulation study. *Production and Operations Management* 13: 340–53. [CrossRef]

Chen, Can, Jeong-Bon Kim, Minghai Wei, and Hao Zhang. 2019. Linguistic information quality in customers' forward-looking disclosures and suppliers' investment decisions. *Contemporary Accounting Research* 36: 1751–83. [CrossRef]

Chiu, Tzu-Ting, Jeong-Bon Kim, and Zheng Wang. 2019. Customers' risk factor disclosures and suppliers' investment efficiency. *Contemporary Accounting Research* 36: 773–804. [CrossRef]

Dahlen, Eric R., Ryan C. Martin, Katie Ragan, and Myndi M. Kuhlman. 2005. Driving anger, sensation seeking, impulsiveness, and boredom proneness in the prediction of unsafe driving. *Accident Analysis & Prevention* 37: 341–48. [CrossRef]

Dou, Yiwei, Ole-Christian Hope, and Wayne B. Thomas. 2013. Relationship-specificity, contract enforceability, and income smoothing. *The Accounting Review* 88: 1629–56. [CrossRef]

DuHadway, Scott, Steven Carnovale, and Vijay R. Kannan. 2018. Organizational communication and individual behavior: Implications for supply chain risk management. *Journal of Supply Chain Management* 54: 3–19. [CrossRef]

Fabbri, Daniela, and Leora F. Klapper. 2016. Bargaining power and trade credit. *Journal of Corporate Finance* 41: 66–80. [CrossRef]

Fauver, Larry, Mingyi Hung, Xi Li, and Alvaro G. Taboada. 2017. Board reforms and firm value: Worldwide evidence. *Journal of Financial Economics* 125: 120–42. [CrossRef]

Flynn, Francis J., and Barry M. Staw. 2004. Lend me your wallets: The effect of charismatic leadership on external support for an organization. *Strategic Management Journal* 25: 309–30. [CrossRef]

Graham, John R., Campbell R. Harvey, and Manju Puri. 2013. Managerial attitudes and corporate actions. *Journal of Financial Economics* 109: 103–21. [CrossRef]
Grinblatt, Mark, and Matti Keloharju. 2009. Sensation seeking, overconfidence, and trading activity. *Journal of Finance* 64: 549–78. [CrossRef]
Grossman, Sanford J., and Oliver D. Hart. 1986. The costs and benefits of ownership: A theory of vertical and lateral integration. *Journal of Political Economy* 94: 691–719. [CrossRef]
Ham, Charles, Mark Lang, Nicholas Seybert, and Sean Wang. 2017. CFO narcissism and financial reporting quality. *Journal of Accounting Research* 55: 1089–135. [CrossRef]
Hambrick, Donald C. 2007. Upper echelons theory: An update. *Academy of Management Review* 32: 334–43. [CrossRef]
Harris, Mary S. 1998. The association between competition and managers' business segment reporting decisions. *Journal of Accounting Research* 36: 111–28. [CrossRef]
Hart, Oliver, and John Moore. 1988. Incomplete contracts and renegotiation. *Econometrica* 56: 755–85. [CrossRef]
Hart, Oliver, and John Moore. 1990. Property rights and the nature of the firm. *Journal of Political Economy* 98: 1119–58. [CrossRef]
Hrazdil, Karel, Jiri Novak, Rafael Rogo, Christine Wiedman, and Ray Zhang. 2020. Measuring executive personality using machine-learning algorithms: A new approach and validity tests. *Journal of Business Finance and Accounting* 47: 519–44. [CrossRef]
Hribar, Paul, and Holly Yang. 2016. CEO overconfidence and management forecasting. *Contemporary Accounting Research* 33: 204–27. [CrossRef]
Hui, Kai W., Sandy Klasa, and Eric P. Yeung. 2012. Corporate suppliers and customers and accounting conservatism. *Journal of Accounting & Economics* 53: 115–35. [CrossRef]
Joskow, Paul L. 1987. Contract duration and relationship-specific investments: Empirical evidence from coal markets. *American Economic Review* 77: 168–85.
Kets de Vries, Manfred F., and Danny Miller. 1985. Narcissism and leadership: An object relations perspective. *Human Relations* 38: 583–601. [CrossRef]
Kim, Jeong-Bon, Zheng Wang, and Liandong Zhang. 2016. CEO overconfidence and stock price crash risk. *Contemporary Accounting Research* 33: 1720–49. [CrossRef]
Klein, Benjamin, Robert G. Crawford, and Armen A. Alchian. 1978. Vertical integration, appropriable rents, and the competitive contracting process. *Journal of Law and Economics* 21: 297–326. [CrossRef]
Kouvelis, Panos, Chester Chambers, and Haiyan Wang. 2006. Supply chain management research and production and operations management: Review, trends, and opportunities. *Production and Operations Management* 15: 449–69. [CrossRef]
Lee, Hau L., Venkata Padmanabhan, and Seungjin Whang. 1997. Information distortion in a supply chain: The bullwhip effect. *Management Science* 43: 546–58. [CrossRef]
Lee, Joon M., Byoung-Hyoun Hwang, and Hailing Chen. 2017. Are founder CEOs more overconfident than professional CEOs? Evidence from S&P 1500 companies. *Strategic Management Journal* 38: 751–69. [CrossRef]
Levin, Jonathan. 2003. Relational incentive contracts. *American Economic Review* 93: 835–57. [CrossRef]
Malmendier, Ulrike, and Geoffrey Tate. 2005. CEO overconfidence and corporate investment. *Journal of Finance* 60: 2661–700. [CrossRef]
Malmendier, Ulrike, Geoffrey Tate, and Jon Yan. 2011. Overconfidence and early-life experiences: The effect of managerial traits on corporate financial policies. *Journal of Finance* 66: 1687–733. [CrossRef]
Petrenko, Oleg, Federico Aime, Jason Ridge, and Aaron Hill. 2016. Corporate social responsibility or CEO narcissism? CSR motivations and organizational performance. *Strategic Management Journal* 37: 262–79. [CrossRef]
Plöckinger, Martin, Ewald Aschauer, Martin R. Hiebl, and Roman Rohatschek. 2016. The influence of individual executives on corporate financial reporting: A review and outlook from the perspective of upper echelons theory. *Journal of Accounting Literature* 37: 55–75. [CrossRef]
Porter, Michael E. 1974. Consumer behavior, retailer power and market performance in consumer goods industries. *Review of Economics and Statistics* 56: 419–36. [CrossRef]
Sunder, Jayanthi, Shyam Sunder, and Jingjing Zhang. 2017. Pilot CEOs and corporate innovation. *Journal of Financial Economics* 123: 209–24. [CrossRef]
Taylor, Terry A., and Erica L. Plambeck. 2007. Supply chain relationships and contracts: The impact of repeated interaction on capacity investment and procurement. *Management Science* 53: 1577–93. [CrossRef]
Tirole, Jean. 1999. Incomplete contracts: Where do we stand? *Econometrica* 67: 741–81. [CrossRef]
Verrecchia, Robert E., and Joseph Weber. 2006. Redacted disclosure. *Journal of Accounting Research* 44: 791–814. [CrossRef]
Williamson, Oliver E. 1975. *Markets and Hierarchies: Antitrust Analysis and Implications*. New York: Free Press.
Williamson, Oliver E. 1983. Credible commitments: Using hostages to support exchange. *American Economic Review* 73: 519–40.
Zuckerman, Marvin, Sybil B. Eysenck, and Hans J. Eysenck. 1978. Sensation seeking in England and America: Cross-cultural, age, and sex comparisons. *Journal of Consulting and Clinical Psychology* 46: 139–49. [CrossRef]
Zuckerman, Marvin. 1971. Dimensions of sensation seeking. *Journal of Consulting and Clinical Psychology* 36: 45–52. [CrossRef]