Customer concentration and corporate risk-taking

Customer Concentration and Corporate Risk-taking[†]

Yue Cao[a], Yizhe Dong[b], Diandian Ma[c], Li Sun[a‡]

[a] Business School, Hunan University, Lushan south road, Changsha, 410082, China

[b] University of Edinburgh Business School, 29 Buccleuch Place, Edinburgh, EH8 9JS, UK

[c] Department of Accounting and Finance, University of Auckland, Auckland Business School, 1142, New Zealand

May 2021

Journal of Financial Stability (Forthcoming)

Abstract

This study empirically investigates the relationship between customer concentration and corporate risk-taking. We find that overall customer concentration significantly reduces corporate risk-taking. However, the relationship varies across different settings. Specifically, the negative relationship between customer-base concentration and corporate risk-taking is only significantly present in more marketized regions, more competitive industries, firms with lower market shares, less innovative and non-state-owned firms, and those without major governmental or state-owned-enterprise customers. Moreover, our panel threshold models indicate significant threshold effects. When customer-base concentration is below the first threshold (low concentration level), it is positively associated with corporate risk-taking. When customer-base concentration increases to above the second threshold, the association turns significantly negative, suggesting that a highly concentrated customer base prompts suppliers to take more precautionary measures and avoid excessive risk-taking. Overall, our findings suggest that the concentration of a supplier's customer base significantly impacts its risk-taking behaviours.

Keywords: customer concentration; corporate risk-taking; governmental major customer; threshold effects

---

[†] We thank Iftekhar Hasan (the Editor), three anonymous referees and participants at the Accounting and Finance Association of Australia and New Zealand 2019 annual conference and the 2019 SSEM EuroConference for their valuable comments. Cao acknowledges financial support from the National Social Science Fund of China (NSSFC) (Grant Number: 20BGL071) and Dong acknowledges financial support from the National Natural Science Foundation of China (NSFC) (Grant Number: 71873103 and 7201142).

[‡] Corresponding author. E-mail: sunny2016@hnu.edu.cn

1. Introduction

The customer-supplier relationship, one of the most important topics related to firms' business operations, has drawn increasing attention from academics and practitioners in recent years. It is common to see that a small set of large customers contributes a sizeable portion of a supplier's sales (e.g., Ellis et al., 2012; Campello and Gao, 2017).

Prior academic research shows that having large customers saves suppliers transactional and discretionary expenses (e.g., Kalwani and Narayandas, 1995; Patatoukas, 2012), and fosters information-sharing and collaboration along the supply chain (e.g., Kumar,1996). Large customers have the motivation and power to monitor their suppliers' product quality and financial status, creating a customer-supplier win-win situation. Such welfare derived from having major customers would improve suppliers' overall financial flexibility. Yet, prior literature also documents that a heavy reliance on a few major customers exposes firms to lower profit margins due to major customers' strong bargaining powers and payment delays (e.g., Saboo et al., 2017; Murfin and Njoroge, 2014), and higher risks of large financial losses resulting from major customers' bankruptcies and walk-outs. It is also common for suppliers to be required to undertake relationship-specific investments which burden them with redeployment expenses and affect their access to credit (e.g., Banerjee et al., 2008; Campello and Gao, 2017; Kale and Shahrur, 2007; Titman, 1984). To cope with the potential financial risks and complications embedded in a concentrated customer base, suppliers may lean towards reserving liquid assets rather than investing in risky projects. Although corporate risk-taking is considered one of the most important factors in a firm's ability to compete, and ultimately, in its performance and survival,[1] there is still little empirical evidence on whether a firm's customer concentration affects its risk-taking and to what extent.

Our study fills this gap in the literature by investigating how the structure of the customer base affects suppliers' risk-taking. We focus on China, the largest emerging market in the world, as our research setting for two reasons. First, research (e.g., Pan et al., 2020) documents that over 40% of listed firms in China have at least one major customer whose sales account for more than 10% of total sales, the cut-off that defines a major customer in Statement of Financial Accounting Standards (SFAS) Nos. 14 and 131 in the U.S., compared to just 8% of listed firms in the U.S. (e.g., Dhaliwal et al., 2016). This suggests that Chinese firms have significantly

[1] Corporate risk-taking is generally defined as firms' willingness to make large and risky resource commitments (Miller and Friesen, 1978).

higher customer concentrations than U.S. firms. However, the legal infrastructure and intellectual property rights in China do not seem to meet Western standards of rule of law (e.g., Chen and Zenglein, 2020). Thus, one-way relationship-specific investments made by suppliers may not be well protected. In such situations, suppliers will be more reluctant to engage in relationship-specific investments, or even general investments to improve their competence in the product market, due to concerns over the potential aftermath of losing major customers without effective legal protection (e.g., Pan et al., 2020). Second, although China's provinces and regions come under the same national-level governance, the extent of government intervention and the development of the regional economic environment differ significantly across this large economy. This unique setting in China provides us with an opportunity to explore whether regional differences and government intervention influence the relationship between customer concentration and suppliers' corporate risk-taking. Our findings will provide generalized and valuable guidance for regulators and governments of countries and jurisdictions with weak legal protection or a significant proportion of state-owned enterprises, regarding how to facilitate and protect cooperation between customers and suppliers.

Using firm-level data from 2009 to 2015 for 1,579 Chinese listed companies, we examine the relationship between customer-base concentration and suppliers' risk-taking. Our primary measure for customer-base concentration is the aggregate sales to the top five customers, scaled by the total sales of the supplier. To proxy for corporate risk-taking, we use the volatility of industry-adjusted firm-level profitability (σ (*ROA*)) over a given three-year period as the primary dependent variable. We also include other variables based on prior literature to isolate the effects of other factors on corporate risk-taking. We find strong statistical evidence that a firm's customer concentration is negatively associated with the level of its risk-taking. Moreover, the economic impact of customer-base concentration on risk-taking is non-negligible. A one-standard-deviation increase in the customer-base concentration results, on average, in a 22.2% decrease in corporate risk-taking, measured by the aforementioned volatility of industry-adjusted firm-level profitability over a given three-year period. We employ both propensity score matching (PSM) and the instrumental variable (IV) approaches to remedy potential endogeneity concerns, caused by omitted variables, self-selection and/or reverse causality, and the results all confirm our main conclusion that firms with more concentrated customer bases undertake fewer risky investments. We also document the robustness of our results to a battery of sensitivity tests. Our results are robust to using an alternative customer-base concentration measure, the Herfindahl-Hirschman Index (HHI),

calculated as the sum of the squares of the shares of sales to each of the top five customers, and four alternative risk-taking measures, Z-score, firms' leverage, R&D investment and overinvestment.

Moreover, we examine the impact of market development conditions, industry competition levels, firms' level of innovation, market power and ownership structure, on the relationship between customer-base concentration and corporate risk-taking. As mentioned above, suppliers with concentrated customer bases may maintain low-risk profiles to protect themselves against the devastating effect of losing major customers. Although in general, there is a negative relationship between customer-base concentration and corporate risk-taking, it is only statistically significant for suppliers operating in more marketized provinces, more competitive industries, those with less innovation, those with less market power and those not owned by the state. We also investigate the effect on risk-taking when having a governmental or state-owned-enterprise major customer. We expect firms with these types of major customers to have a lower need and incentive to reduce risk-taking. The results support our expectation and show that the negative relationship between customer concentration and risk-taking is only significant for suppliers that do not have major governmental or state-owned customers.

Given the benefits and risks embedded in the customer base, whether firms are active or conservative in taking on risky investments may be determined by the level of their reliance on major customers and their customers' power. Therefore, lastly, we explore whether there is a threshold effect of customer concentration on corporate risk-taking by employing a panel threshold regression model. We find that there are two thresholds in the relationship between customer-base concentration and corporate risk-taking, at 9.1% and 27.3%, respectively. The results confirm that firms with a highly concentrated customer base (i.e. for which the sales share of the five largest customers is greater than 27.3%) tend to engage less in risk-taking behaviours.

Our study makes several contributions. First, our study complements and extends the literature examining the determinants of corporate risk-taking (e.g., John et al., 2008; Faccio et al., 2011; Mishra, 2011; Cain and McKeon, 2016; Ferris et al., 2017). We investigate an important and previously unexplored attribute, customer concentration, and find its association with corporate risk-taking. Second, we further document that, when customer concentration increases to a certain level, firms recognise the potential risks embedded in their customer base, and tend to take precautionary measures and become more conservative in their investments.

Prior studies find that suppliers with a greater customer concentration are likely to hold more liquid assets (e.g., Itzkowitz, 2013), maintain a lower leverage ratio (e.g., Banerjee et al., 2008) and reduce discretionary spending (e.g., Raman and Shahrur, 2008). Third, this study contributes to the emerging literature addressing how a firm's relationship with its stakeholders affects its overall corporate strategy and decision-making. Previous literature shows that external stakeholders (such as customers, short sellers, debt holders etc.) have important effects on firms' financial structure (e.g., Kale and Shahrur, 2007), financial decisions (e.g., Fee and Thomas, 2004), corporate tax avoidance (e.g., Chyz et al., 2013; Huang et al., 2016), inventory management (e.g., Korcan and Patatoukas, 2016) and financial reporting quality (Massa et al., 2015). We provide new insights on the role buyer-supplier relationships play in the risk choices made within corporate investment decisions. Finally, this study adds to the evidence on the effects of different settings and governmental customers on corporate decisions (e.g., Banerjee et al., 2008; Huang et al., 2016), and shows that different settings and reliance on different types of principal customers have differential effects on suppliers' risk-taking. The presence of the government or state-owned enterprises as major customers does not significantly reduce supplier firms' risk-taking. Our findings can be generalized to many other emerging countries with lax law enforcement and investor protection or having a significant proportion of state-owned enterprises.

The paper proceeds as follows. Section 2 discusses prior research and develops our empirical hypothesis. Section 3 describes our research design with respect to the data, variable construction and empirical models. Section 4 and 5 present the empirical results, robustness tests and additional analyses. Finally, section 6 concludes.

2. Literature review and hypothesis development

Given the importance of effective risk management, a growing number of studies are exploring the determinants of corporate risk-taking activities. Specifically, the extant literature finds corporate risk-taking behaviour to be affected by large shareholders' characteristics (e.g., Faccio et al., 2011), ownership types (e.g., Biubakri et al., 2013), option-based compensation paid to senior managers (e.g., Kini and Williams, 2012), the CEO's gender, personal risk-taking propensity and social capital (e.g., Faccio et al., 2016; Cain and Mckeon, 2016; Ferris et al. 2017), creditor rights (e.g., Acharya et al., 2011), investor protection (e.g., Wurgler, 2000; John et al., 2008), insider trading restrictions (e.g., Kusnadi, 2015), political institutions (e.g.,

Boubakri et al., 2013), regulation changes (e.g., Bargeron et al., 2010) and the national culture (e.g., Li et al., 2013). However, whether corporate risk-taking is affected by major customers, one of the firms' most important external stakeholders, remains unexplored.

Prior literature shows that external stakeholders have significant effects on firms' financial structures (e.g., Kale and Shahrur, 2007), financial decisions (e.g., Fee and Thomas, 2004), corporate tax avoidance (e.g., Chyz et al., 2013; Huang et al., 2016), inventory management (e.g., Korcan and Patatoukas, 2016) and financial reporting quality (e.g., Massa et al., 2015). It is documented that the structure of a firm's customer base affects a wide spectrum of corporate policies and business outcomes. Firms that have strong and stable relationships with their major customers are frequently able to impart positive financial outcomes in their analyst reports, management forecasts and IPO prospectuses (e.g., Johnson et al., 2010), due to the economies of scale, lower operating expenses, and consequently more efficient operations and asset utilization that a concentrated customer base can afford (e.g., Irvine et al., 2016; Patatoukas, 2012). The efficiency in operations and asset utilization is achieved through the sharing of information and collaboration along the supply chain, through routine interactions carried out at a low cost (e.g., Kalwani and Naryandas, 1995; Kumar, 1996), the streamlining of inventory management, reductions in transaction costs and discretionary expenses, such as selling, marketing, general and administrative expenses (e.g., Kalwani and Narayandas, 1995; Patatoukas, 2012), and enhanced working capital management (e.g., Kinney and Wempe, 2002). Additionally, having long-term and recurring revenues from major customers encourages collaboration on innovation, motivates suppliers to engage in risky projects such as R&D and to grow into new and expanded product areas, and improves suppliers' product quality and operating competence (e.g., Cohen and Frazzini, 2008; Krolikowski and Yuan, 2017). Such outcomes, in turn, enable suppliers to enhance existing customer-supplier relationships and increase their market share and competitive position in the product market (e.g., Kim and Wemmerlov, 2015; White, 1996).

Moreover, in order to secure the provision of products to meet their demand, and to protect their relationship-specific investments in suppliers, large customers have the motivation and power to monitor and certify their suppliers (e.g., Chevalier and Goolsbee, 2009; Itzkowitz, 2015). The certification effect sends information to capital providers, which complements financial statements and reduces information asymmetry (e.g., Johnson et al., 2010; Wang, 2012). Consequently, suppliers with principal customers are more likely to have better access to external funds with a lower cost of capital, and thus greater financial flexibility. A strong

and well-integrated supply chain could give suppliers more joint investment opportunities with their customers, which can be considered a mechanism for risk-sharing. Research shows that better risk-sharing tends to promote more risk-taking (e.g., Acemoglu and Zilibotti, 1999; Ambrus et al., 2014). Overall, having major customers gives suppliers essential competitive advantages (Gosman, 2004) and draws suppliers and their customers into a value-creation system that leads to better financial and market performance (e.g., Irvine et al., 2016; Itzkowitz, 2015; Patatoukas, 2012).

Despite the benefits reaped from having major customers, however, many studies show that relying heavily on a few major customers leads to high costs and risks, thereby influencing corporate policies. The existing literature argues that high customer concentration hurts the supplier firms' profits and their shareholders' value due to major customers' strong bargaining powers (e.g., Murfin and Njoroge, 2014; Saboo et al., 2017). These strong bargaining powers are not only related to purchase prices and payment delays, but also likely to bring more hold-up costs to relationship-specific investments than benefits to the suppliers (e.g., Balakrishnan et al., 1996), making suppliers reluctant to make relationship-specific investments and update their products and services, impeding innovation, and resulting in the loss of competitive advantages in the market (e.g., Krolikowski and Yuan, 2017).

Nevertheless, such compromises do not guarantee a continuance of purchase orders. If the major customer decides to leave the supplier, or in the extreme case goes bankrupt, the supplier could suffer high costs associated with losing and replacing the customer, as well as a considerable amount of uncollectible debt, and experience a subsequent sharp reduction in cash flows and profit margins (e.g., Banerjee et al., 2008; Hertzel et al., 2008; Itzkowitz, 2013; Kolay et al., 2016). Those suppliers who undertake relationship-specific investments and provide unique and customized operations and products suffer greater losses in such circumstances (e.g., Kale and Shahrur, 2007; Titman and Wessels, 1988). To minimize the negative consequences of major customers' bargaining powers and the financial shock of losing such customers, firms with highly concentrated customer bases tend to hold more liquid assets (e.g., Itzkowitz, 2013), reduce discretionary spending (e.g., Raman and Shahrur, 2008), cut dividend pay-outs to fund investment expenditures (e.g., Wang, 2012) and increase cash holdings through tax avoidance (e.g., Huang et al., 2016). They also take a more cautious approach to borrowing money so that they can remain solvent and keep their cost of capital under control (e.g., Itzkowitz, 2013; Wang, 2012). Accordingly, given the risks and costs imposed by major customers, firms with more concentrated customer bases tend to pay a higher

cost of equity capital (e.g., Dhaliwal et al., 2016) and have increased interest rate spreads and more restrictive covenants in new (or renewed) bank loans (e.g., Campello and Gao, 2017). As such, the liquidity constraints may limit suppliers' access to resources and their commitments to risky investments.

Further, maintaining lower leverage and a lower risk profile forms part of suppliers' commitments to their customers (e.g., Banerjee et al., 2008; Itzkowitz, 2013; Titman and Wessels, 1988). Customers expect suppliers to be in a stable financial state and to provide parts and services in a consistent manner, and do not want them taking on many risky investments that could increase their probability of financial distress or liquidation, and affect their capability to supply goods or services (e.g., Dhaliwal et al., 2016; Titman, 1984). Therefore, major customers have incentives to wield great influence over suppliers' risk-taking decisions, and are reluctant to commit to relationships with suppliers that have high leverage, low financial flexibility and little ability to invest in relationship-specific assets (e.g., Itzkowitz, 2015; Maksimovic and Titman, 1991). Consequently, because of a desire to strengthen relationships with major customers, suppliers are more likely to maintain low risk profiles and to be risk averse. Given the above discussions, we predict that customer concentration will be negatively associated with corporate risk-taking.

3. Research design

3.1 Sample selection and data

The data were collected from the Wind and China Stock Market and Accounting Research (CSMAR) databases. The sample was chosen based on the requirement that firm-level data be available for computing our risk-taking and customer concentration measures, along with other key firm characteristics used in the tests. Although "*Standard No.2 for the Contents and Formats of Information Disclosure by Companies Offering Securities to the Public – Contents and Formats for Annual Reports*", issued by the China Securities Regulatory Commission (CSRC), has required listed companies to disclose their aggregate sales to their top five customers since 2007, most did not being reporting such detailed customer information until 2009. Thus, we begin our sample period in 2009. We begin our sampling process by identifying all firms listed on the Shanghai and Shenzhen stock exchanges over the period of 2009-2015[2].

[2] Although our main empirical analysis covers the period 2009 through 2015, we need two more years of ROA data to calculate the risk-taking measures. 2017 was the latest data we could obtain when we worked on this research project. Therefore, our sample stops in 2015.

To construct our final sample, we clean the data according to the following steps. Firstly, to mitigate the impact of distressed stocks, we exclude ST and PT firms (1,706 firm-year observations) from the initial sample (11,164 observations).[3] Secondly, we exclude 184 firm-year observations related to the financial industry, based on the CSRC industry classification standard. We further exclude delisted firms and firms with missing values of dependent variables, independent variables and control variables (4,338 observations dropped). Finally, we exclude firms operating under abnormal conditions (e.g. firms with negative equity and negative pretax income). The final sample consists of 4,842 firm-year observations. To reduce the impact of outliers, we winsorize all continuous variables at the top and bottom 1% of the distribution.

3.2 Measurement of main variables

3.2.1 Customer concentration measures

Extant studies have created three proxies to measure customer concentration (e.g., Cen et al., 2017; Irvine et al., 2016; Dhaliwal et al., 2016; Huang et al., 2016; Itzkowitz, 2013; Patatoukas, 2012). The first is a principal customer indicator variable that is set to one if a supplier has at least one customer that accounts for 10% or more of total sales and zero otherwise (the 10% cut-off aligns with the Statement of Financial Accounting Standards (SFAS) Nos. 14 and 131, which require listed firms to disclose information about each of their major customers that individually accounts for more than 10% of their total sales). The second proxy is an HHI of sales to major customers, and the third is a ratio of the sum of the total sales to all major customers to the firm's total sales. Positive statistical correlations are found between all three measures (e.g., Dhaliwal et al., 2016).

Unlike the SFAS's definition of a major customer, the CSRC's definition identifies major customers as the five customers who account for the highest proportions of the supplier's total sales[4]. Therefore, we use the aggregate sales to the top five customers, scaled by the total sales of the supplier, as our customer concentration proxy, according to the distinctive regulation

[3] ST stands for special treatment, PT for particular transfer. The Shanghai and Shenzhen stock exchanges mark shares as ST or PT to inform investors that a firm has financial issues or is encountering abnormal conditions that may endanger investors' interests (www.sse.com.cn).

[4] Using a 10% threshold of total sales to classify a customer as a major customer entails some degree of subjective judgment. Some customers that contribute less than 10% of total sales could still be considered important to a firm's business. For example, if the revenue generated from sales to a particular customer were 9.9%, just below 10%, the loss of that customer would have the same material adverse effect on the firm's business as the loss of one that contributed 10%. Therefore, unlike SFAS No. 14 and No. 131, the CSRC prefers to require firms to disclose the sales to their top five customers, instead of setting a threshold to define major customers and dependent suppliers.

applied in China rather than the research paradigm developed for US settings. Defining major customers based on their importance to the supplier rather than applying a single cut-off percentage is also consistent with a 'one size does not fit all' approach to corporate governance (Bradbury et al., 2019).

Thus,

$$Customer = \sum_{j=1}^{5} \left(\frac{Sales_{ijt}}{Sales_{it}} \right)$$

where $\sum_{j=1}^{5} Sales_{ijt}$ represents supplier *i*'s sales to its top five customers in year *t*. Thus, the higher (or lower) is the proportion of aggregate sales that the top five customers contribute to the supplier's total sales, the higher (or lower) is the customer concentration. We verify the robustness of our results against an alternative proxy for customer concentration that is widely used in the literature, namely, the HHI of sales revenue to the five largest customers.

3.2.2 Corporate risk-taking measures

Engaging in riskier investment and corporate operations could lead to more volatile returns to capital. Therefore, we use the volatility of industry-adjusted profitability as our primary proxy for the degree of corporate risk-taking[5]. The profitability is measured by the firms' return on assets (*ROA*), which is defined as the ratio of earnings before interest, tax, depreciation and amortization (EBITDA) to total assets. This approach has also been adopted by many other studies such as Faccio et al. (2011), John et al. (2008) and Ferris et al. (2017). The volatility of profitability over a three-year overlapping period is computed as

$$RiskT_{it} = \sqrt{\frac{1}{N-1}\sum_{n=1}^{N}(Adj\_ROA_{in} - \frac{1}{N}\sum_{n=1}^{N} Adj\_ROA_{in})^2} \mid N = 3 \qquad (1),$$

where

$$Adj\_ROA_{in} = \frac{EBITDA_{in}}{Asset_{in}} - \frac{1}{X_n}\sum_{k=1}^{X}\frac{EBITDA_{kn}}{Asset_{kn}} \qquad (2)$$

Here, ROA_{in} is industry-adjusted each year by the subtraction of the sample-wide mean *ROA* for the firm's industry, as calculated using equation (2), while *Asset* is the financial year-end total assets. The *X* in equation (2) is the total number of firms in the same industry. The

[5] The advantage of this measure is that it captures the consequences of corporate risk-taking behaviours and thereby provides a more complete picture, with a horizon for corporate risk-taking that is longer than would be obtained from any individual financial ratio from a particular year.

volatility of a firm's *ROA* (i.e., the standard deviation of the industry-adjusted *ROA*) is calculated over three-year overlapping periods (2009–2011, 2010–2012, 2011–2013, 2012–2014, 2013–2015, 2014–2016 and 2015–2017) using equation (1)[6]. A high (low) volatility of a firm's *ROA* indicates a high (low) level of corporate risk-taking. In addition, we follow prior studies and use four alternative risk-taking measures, namely leverage (Faccio et al., 2016), the Z-score (e.g., Nakano and Nguyen, 2012), R&D investment (e.g., Coles et al., 2006) and overinvestment (e.g., Richardson, 2006), to test the robustness of the results generated using the volatility of industry-adjusted firm-level profitability in section 4.2.

3.3 Empirical methodology

To test the overall influence of customer concentration on corporate risk-taking, we construct the following model:

$$RiskT_{it} = \alpha_0 + a_1 Customer_{it} + \tau' Controls_{it} + Firm\ fixed\ effects + Year\ fixed\ effects + \varepsilon_{it} \quad (3)$$

Here, as just described, the corporate risk-taking, *RiskT*, is the volatility of industry-adjusted firm-level profitability over a three-year overlapping period, and ε_{it} is the stochastic error term. Our variable of interest is the customer concentration (*Customer*) that is calculated as the aggregate sales to the top five customers divided by the supplier's total sales. The coefficient on *Customer*, α_1, in equation (3) is used to test our hypothesis, and if coefficient α_1 is significantly negative, it will suggest that a high level of customer concentration is associated with a low level of corporate risk-taking and support our hypothesis.

Following previous studies (e.g., John et al., 2008; Faccio et al., 2011; Li et al., 2013; Boubakri et al., 2013; Faccio et al., 2016; Cain and MeKeon, 2016), our models also include a set of firm-level control variables. We include the natural logarithm of total assets (*Size*) to control for the effect of firm size. Perez-Quiros and Timmermann (2000) and Bargeron et al. (2010) suggest that, as smaller firms are more aggressive and involved in more risky investment than larger firms, firm size may be negatively correlated with risk-taking. *Leverage,* defined as the ratio of total debt to total assets, may be negatively associated with corporate risk-taking, since a high debt-to-asset ratio will restrict corporate investment (e.g., Li et al., 2013). On the other hand, since a high debt-to-asset ratio means that the company has a higher willingness to

[6] It is worth noting that our main findings remain unchanged if we measure the volatility of industry-adjusted firm-level profitability over five-year overlapping periods (results available upon request). However, since that approach would significantly reduce the observations, we prefer to use three-year overlapping periods to calculate this main measure of corporate risk-taking.

take risks, *Leverage* and risk-taking may also be positively correlated. Accordingly, we do not provide a directional prediction for the coefficient on *Leverage.* Asset tangibility (*Tangibility*) is defined as the ratio of total investment in property, plant, and equipment to total assets. The value of tangible assets is easy to observe and evaluate, which helps to reduce the information asymmetry between financial institutions and lenders, ease financing constraints, and increase investment (e.g., Campello and Hackbarth, 2012; Norden and Kampen, 2013). We expect the sign of the coefficient of *Tangibility* to be positive. Intangible assets (*Intang*), defined as the ratio of net intangible assets to total assets, may be positively associated with corporate risk-taking, because the excess profits generated by technical intangible assets prompt companies to increase investment (e.g., Ohlson, 1995). However, the intangible assets of Chinese listed companies mainly include various types of use rights (especially land use rights), and the proportion of technical intangible assets is relatively low. Thus, we do not provide a directional prediction for the coefficient on *Intang.*

We include *ROA*, defined as the ratio of EBITDA to total assets, to control for the effect of profitability. A high rate of return on assets means that companies have the motivation and ability to make more investments, but it may also prompt companies to be satisfied with their current profitability levels and unwilling to take more risks (e.g., Faccio et al., 2011). We, therefore, do not make a directional prediction for the coefficient on *ROA*. Equity income (*Eqinc*), the ratio of equity income to total assets, reflects the ability and motivation of firms to continue investing. Therefore, we expect the coefficient on *Eqinc* to be positive. The book-to-market ratio (*BM*) is defined as the ratio of the book value of assets to the market value of equity (i.e. the larger is the *BM*, the greater the growth opportunities for the company). We expect the coefficient on *BM* to be negative because firms with greater growth opportunities are likely to make more risky investments (e.g., Habib and Hasan, 2015). Sales growth (*Growth*), calculated as the annual growth rate of revenue, reflects firms' operating performance relative to the previous year. Investment is more rewarding when sales growth is high (e.g., Anthony and Ramesh, 1992). Thus, sales growth is likely to be positively linked to firms' risk-taking.

PayTurn is defined as the ratio of net credit purchases to average accounts payable. A lower accounts payable turnover ratio means that companies can obtain more commercial credit financing from suppliers, which can alleviate financing difficulties (e.g., Yang, 2011), and improve the level of corporate investment. However, excessive commercial credit financing increases the repayment pressure and the risk of a cash shortage, which is not conducive to

corporate investment. Cash flow rights (*Rights*) is defined as the ownership rights of a firm's largest shareholder. The higher the shareholding ratio of the largest shareholder, the greater the risk that the largest shareholder has to bear due to investment failure. Therefore, the largest shareholder may avoid risk to prevent the loss of expected short-term benefits when their shareholding ratio is relatively high (e.g., Chin et al., 2009).

To control for the effect of ownership structure, we include *State* which is an indicator variable that equals one if a firm is ultimately controlled by the state, and zero otherwise. State-owned enterprises generally bear policy burdens that may lead firms to pursue conservative investments (e.g., Boubakri et al., 2013). For example, government policies that seek to maximize social stability and employment may constrain SOEs' ability to undertake risky investments (e.g., Fogel et al., 2008). On the other hand, SOEs enjoy the advantage of either implicit or explicit financial and regulatory support from the government. The government protection encourages SOEs to take excessive risks as the losses and excess costs will invariably be covered by the government (e.g., Dong et al., 2014). We therefore do not make a directional prediction for the coefficient on *State*. Finally, we control for risk-taking differences across firms and years by including firm and year fixed effects. For definitions of the control variables, see Appendix A.

3.4 Summary statistics

Table 1 presents sample descriptive statistics. Here, we can see that corporate risk-taking, *RiskT*, has a mean (median) value of 0.101 (0.030), consistent with prior research (e.g., Faccio et al., 2016). The maximum value of 1.180 and the minimum value of 0.0002 show a substantial difference in firms' commitment to risky resources. The *leverage* ratio has a mean (median) value of 0.403 (0.394). The maximum value of 0.854 and minimum value of 0.035 show a significant difference in firms' financing policies. *Z-score* indicates the level of bankruptcy risk of a firm. The maximum and minimum values of *Z-score* show a considerable difference in firms' bankruptcy risk. Similarly, the values for R&D expenditure scaled by operating income indicate that the firms exhibit substantial differences in their amounts of R&D investment. Also, we find that 37.8% of the companies in the sample have overinvested. On average, the sales to the top five customers, *Customer*, account for 30.2% of a firm's total sales, which is consistent with Dhaliwal et al. (2016), who find that, on average, major customers account for 31% of suppliers' total sales. Also evident is the considerable difference between

the highest customer concentration of 96.8% and the lowest customer concentration of 1.6%. The statistics of the other variables summarized in Table 1 can be interpreted similarly.

[*Insert Table 1 about here*]

4. Empirical results

4.1 Baseline results

This section empirically tests the effect of customer concentration on corporate risk-taking proxied by return volatility. Table 2 reports the results of the baseline regression (i.e. equation 3) with *t*-values calculated using clustered standard errors across firms. The first column shows that, when controlling for firm fixed effects but without including other control variables, customer-base concentration, *Customer*, is negatively associated with corporate risk-taking, *RiskT*, at the 1% significance level, which indicates that firms with a higher customer concentration are more risk-averse and less likely to undertake risky investments. Columns (2) and (3) present the estimation results of regressions which include the control variables and firm fixed effects, and the control variables and both firm and year fixed effects, respectively. These two columns show results consistent with column (1), confirming the significant negative effects of customer concentration on corporate risk-taking.

The results in columns (1), (2) and (3) all support our prediction and indicate that a highly concentrated customer base will increase potential risks for the supplier, such as that of a sizeable drop in the supplier's cash flow and payment delays, making the supplier more likely to be conservative in their investment strategies, and to take precautions against the additional risks associated with operating, investing or financing activities. Taking column (3), for example, where firm and year fixed effects are controlled for, the coefficient on customer concentration is -0.103 and implies that a one-standard-deviation increase in customer concentration results, on average, in a 21.8% decrease in the volatility of industry-adjusted firm-level profitability (i.e. corporate risk-taking). The results also show other factors that are related to corporate risk-taking. We find that firm size (*Size*) is significantly negatively related to it, while asset tangibility (*Tangibility*) and equity income (*Eqinc*) are significantly positively related to it. All these findings are consistent with prior studies; see, for example, Faccio et al. (2011) and Ferris et al. (2017).

[*Insert Table 2 about here*]

4.2 Robustness analysis

In this section, we conduct several additional tests to examine the robustness of our main findings. First, we use both an IV approach and estimations based on a propensity score matched sample to correct for the possible endogeneity problem in our study. Moreover, we employ several alternative measures of the main variables of interest, reducing the potential for measurement errors.

4.2.1 Endogeneity concerns

Although the results presented above suggest that a more concentrated customer base tends to discourage suppliers from undertaking risky investments, our results might be contaminated by potential endogeneity. One source of concern comes from self-selection and reverse causality. For example, customers might choose suppliers with a risk profile that best suits their preferences, rather than major customers directly influencing their suppliers' risk-taking behaviour. Suppliers are also likely to maintain a lower risk profile to attract and maintain more big customers, which will lead to a concentrated customer base.

To alleviate the endogeneity concern that determinants of having a major customer also simultaneously determine the firm's risk-taking, we firstly use the PSM technique to control for the differences in firm characteristics between firms with a concentrated customer base and firms without a concentrated customer base. Following previous studies, we define a firm as having a concentrated customer base if it has a major customer that accounts for at least 10% of its sales (e.g., Banerjee et al., 2008; Cen et al., 2017; Dhaliwal et al., 2016; Itzkowitz, 2013; Patatoukas, 2011)[7]. We then assign the firms with a customer that contributes more than 10% of total sales to the treatment group, and the other observations into the initial control group[8]. Next, we calculate the predicted probability (i.e. represented by the propensity score) that a firm with given characteristics has at least one major customer. The PSM method involves pairing treatment and comparison units that are similar in terms of their observable characteristics. The principle of covariate selection in the PSM is to include relevant variables that may affect the outcome and treatment variables so as to meet the ignorability assumption (e.g., Rosenbaum and Rubin, 1983). Our choice of matching covariates is motivated by prior

[7] IFRS 8 and SFAS 131 set a cut-off of 10% for the customer disclosure requirement and ignore the risks, if any, from customers that account for less than 10% of a firm's revenue. The cut-off for the definition of a major customer in the regulations is supported by Pedersen and Anderson (2006), who note that, if suppliers spread their revenue across a portfolio of customers, the customers will be in a weak bargaining position, and their influence on the suppliers will be negligible.

[8] In robustness tests, we also applied 8%, 12% and 15% cut-off criteria to define the treatment firms, respectively. Our results are robust to using these alternative cut-off points.

evidence on the determinants of customer-base concentration. Specifically, we calculate the propensity score using firm characteristics including firm size, asset tangibility, the ratio of net intangible assets to total assets, leverage, ROA, equity income, sales growth, and accounts payable turnover.

Compared with small enterprises, large enterprises generally have a stronger influence in their industry and more bargaining power with their customers (e.g., Chipty and Snyder, 1999). Campello and Hackbarth (2012) show that the value of tangible assets is easy to observe and evaluate, which helps to reduce information asymmetry and ease financing constraints. Customers may be more likely to choose a supplier with more tangible assets. Intangible assets generally include reputation, brand, relationships, people, and other intellectual property, and provide firms with sustainable competitive advantages (e.g., Pfarrer, Pollock and Rindova, 2010). Customers are more likely to sign large contracts and maintain stable relationships with more reputable suppliers. Moreover, a high debt-to-asset ratio will increase repayment pressure as well as financial risks, and customers are more willing to cooperate with suppliers in a sound financial condition (e.g., Itzkowitz, 2013). ROA, equity income, and sales growth reflect the supplier's profitability and growth opportunities, which are important considerations for customers when choosing suppliers (e.g., Itzkowitz, 2013). A lower accounts payable turnover ratio means that companies can obtain more commercial credit financing from suppliers and have a higher position in the supply chain (e.g., Yang, 2011). However, Deloof (2003) shows that excessive commercial credit payments affect a firm’s reputation, which prevents the timely supply of raw materials. We estimate a logit model including all of the abovementioned variables and calculate the propensity score for each firm using the predicted probabilities from the logit model. We then match, with replacement, firms with at least one major customer to those without one, using the closest propensity score, to generate a matched control group.

Figures 1 and 2 show the density plots for the treatment- and control-group observations before and after they are matched. Panel A of Table 3 shows the differences in the means between the treatment and control groups. The results reveal that, after matching, the treatment and control groups appear to be indistinguishable in terms of the firm characteristics mentioned above and confirm the validity of our matching strategy. The estimation results based on the PSM sample are reported in the first column of Panel B of Table 3. Consistent with our primary findings, we again find that customer concentration is significantly negatively associated with corporate risk-taking.

To further enhance the robustness of our results and address endogeneity concerns, we use a two-stage least squares (2SLS) IV approach to validate our main findings. Following prior literature (e.g., Dhaliwal et al., 2016; Itzkowitz, 2013), we use the lag of the industry-year median customer concentration, *Ind_Cust*, as an IV in the first-stage regression to examine the possible determinants of customer concentration[9]. We believe that our IV satisfies the two conditions for a valid instrument: relevance and the exclusion restriction (e.g., Larcker and Rusticus, 2010). The industry-level median represents well the structure of the customer base in the industry, and other industry characteristics. It is correlated with individual customer concentration but is beyond individual influences as long as the industry is large enough. The results of the first stage are reported in column (2) of Panel B of Table 3 and show that the coefficients for the instrument are significantly positive and so validate the relevance condition. Column (3) of Panel B of Table 3 provides the results of the second stage, showing that overall customer concentration is negatively associated with corporate risk-taking. The results support our main findings and are consistent with the PSM results. We also conduct several tests for checking instrument validity. We perform the Cragg-Donald test for model identification. The Cragg-Donald Wald F-statistic is 44.65, which is above the critical value suggested by Stock and Yogo (2005), indicating that our IV is relevant and does not suffer from the weak instrument problem.[10] Furthermore, the Anderson canon. corr. LM statistic is 12.83 (p-value is 0.00), suggesting that our instrument passes the underidentification test. Finally, following prior literature (e.g., Hasan et al., 2017), we examine the exclusion restriction by including the instrument as an additional control variable in the baseline model. The result, in column (4) of Panel B of Table 3, shows that the IV is uncorrelated with suppliers' risk-taking and has no explanatory power in the regression.

[*Insert Figure 1 and Figure 2 about here*]

[*Insert Table 3 about here*]

[9] We have instrumented our customer concentration variables in the 2SLS models. However, the control variables may also be endogenous. Therefore, we further conducted a robustness test by using the lag of the control variables in the first-stage regression to alleviate the endogeneity concern regarding the control variables. The untabulated results remained quite similar and are available upon request.

[10] The Cragg-Donald statistic can be thought of as the matrix-analogue of the first stage F-statistic and they are equivalent when there is a single endogenous regressor.

4.2.2 Alternative proxies robustness checks

In this section, we repeat our main analysis by employing alternative proxies for corporate risk-taking and customer-base concentration. Coles et al. (2006) posit that firms' risk will be increased by alterations in financial policy, specifically increased leverage. Similarly, R&D expenditure is viewed as a high-risk investment compared to capital expenditure (e.g., Kothari et al., 2001; Coles et al., 2006). Z-score comprehensively reflects firms' financial status and bankruptcy risk from the aspects of profitability, liquidity and financial structure. Xia et al. (2015) find a significantly positive correlation between firms' overinvestment and their risk-taking. We, therefore, first follow prior studies and use leverage (e.g., Coles et al., 2006), Z-score (e.g., Nakano and Nguyen, 2012), R&D investment (e.g., Coles et al., 2006) and overinvestment (Richardson, 2006) as four alternative proxies for corporate risk-taking, and test the robustness of the results generated using ROA volatility, our main proxy for corporate risk-taking. We then regress the HHI, an alternative proxy for customer concentration, on the five proxies for corporate risk-taking, namely, ROA *volatility*, *Leverage*, *Z-score*, *R&D* and *Overinvest*, respectively[11]. The HHI is the sum of the squares of the individual customers' sales as a proportion of the supplier's total sales (e.g. Dhaliwal et al., 2016):

$$Customer\ \ HHI_{it} = \sum_{j=1}^{J} \left(\frac{Sales_{ijt}}{Sales_{it}}\right)^2$$

Here, $Sales_{ijt}$ represents supplier *i*'s sales to major customer *j* in year *t*. Because we have five measures of risk-taking and two measures of customer concentration, we obtain nine additional sets of regression results that are reported in Table 4. In all these regressions, we retain all control variables and the fixed effects used in the baseline regressions. Columns (1)-(5) show the results for the regressions of the alternative customer concentration proxy, *HHI*, on the five measures of corporate risk-taking, and columns (6)-(9) report the results for the regressions of our main customer concentration measure, *Customer,* on the four alternative risk-taking proxies. The results show that the coefficients on all customer concentration proxies are negative and statistically significant, suggesting that firms with highly concentrated customer bases are likely to discourage risk-taking. These results provide additional evidence that our main findings are robust to alternative proxies.

[*Insert Table 4 about here*]

[11] For definitions of the alternative proxies, see Appendix A. We used a fixed-effect linear probability model, where the overinvestment indicator variable is regressed on the two customer concentration measures, to examine whether customer-concentrated firms tend to be overinvested firms.

4.2.3 Analysis of changes in customer-base concentration

A cause-effect relationship between customer-base concentration and suppliers' risk-taking implies that changes in customer concentration are associated with changes in risk-taking. Therefore, in this section, we examine the intertemporal association between changes in customer-base concentration and changes in supplier firms' risk-taking. The dependent variable, $\triangle RiskT$, is defined as the annual change in suppliers' risk-taking, i.e. $RiskT_{i,t}$-$RiskT_{i,t-1}$. The primary explanatory variable, $\triangle Customer$, is the annual change in customer-base concentration, i.e. $Customer_{i,t}$-$Customer_{i,t-1}$. Table 5 presents results from the regression. The results show that $\triangle Customer$ is negatively and significantly associated with the change in corporate risk-taking, indicating that suppliers will reduce their risky investment when their customer-base concentration increases.

[*Insert Table 5 about here*]

5. Additional analysis

Although, in general, greater customer concentration means the supplier's risk is higher and discourages corporate risk-taking, in this section, we extend our analysis in several ways to provide further empirical evidence on cross-sectional differences in this relationship. To achieve this purpose, we divide the full sample into sub-samples to examine and discuss the effects that (1) region-level marketization, (2) industry-level competition, (3) market share, (4) firm-level innovation, (5) state-owned suppliers, and (6) governmental and state-owned major customers have on corporate risk-taking. We also provide an additional specification to test whether there are threshold effects of customer concentration on suppliers' risk-taking.

5.1 Sub-sample analyses

5.1.1 Marketization

Since the start of the reform and opening-up policy in 1978, China has experienced substantial economic growth and is now the second-largest economy in the world (World Bank, 2017). Although China's provinces and regions come under the same national-level governance, the extent of government intervention and the development of the regional

economic environment differ significantly across this large economy. This situation prompts us to test whether the degree of marketization in different regions influences the relationship between customer concentration and suppliers' corporate risk-taking.

Marketization refers to the process of transforming a planned economic system into a market-based system. Greater marketization (i.e., a freer economic environment) stimulates competition among suppliers and enhances information transparency. For example, increased competition and improved information transparency provide customers with more options with regard to balancing costs and quality should they decide to change suppliers (e.g., Barroso and Picón, 2012). Suppliers faced with the threat of competitors will treat maintaining and enhancing their relationships with existing customers as more important than will their counterparts in a less marketized environment, where customers will have fewer suppliers to choose from and limited information about other potential suppliers because of the less transparent information environment (e.g., Petersen and Rajan, 1997). As a result, in more marketized regions, suppliers are more likely to cater to major customers' preferences by maintaining a less risky profile and undertaking more relationship-specific investments. They will also tend to hold more liquid assets to buffer against any fallout from losing major customers to competitors. Hence, we anticipate a negative association between customer concentration and corporate risk-taking in more marketized regions. In less marketized regions, however, where both suppliers and customers typically face more information asymmetry, switching suppliers or establishing relationships with new customers involves higher risks and costs. We therefore predict that financial expenditure on maintaining or enhancing existing customer relationships will be of less significance to suppliers in these regions than it will be to their counterparts in more marketized regions, and thus corporate risk-taking will be less sensitive to customer concentration in the less marketized regions. To examine this, we use the provincial marketization index designed by Fan et al. (2017) to measure the level of marketization in China's provinces over the period of 2008-2015, and we match that index to each company, by year and company location. We then divide our samples into two sub-samples for each year, *H_Mkt* and *L_Mkt*, where *H_Mkt* (*L_Mkt*) includes observations in the more (less) marketized regions, i.e. those with a marketization index higher (lower) than the annual median. We apply equation (3) to both samples, and the results are shown in columns (1) and (2) of Table 6. The results support our expectation that customer concentration in more (less) marketized regions would be negatively (insignificantly) associated with corporate risk-

taking, and provide evidence that suppliers in more marketized environments are more dedicated to maintaining major customers by taking fewer risks.

5.1.2 Competition

Research documents that customer loyalty is low when customers have more options in a highly competitive environment (e.g., Matzler et al., 2015). Many suppliers therefore develop customer retention programmes to deter customers from leaving them for their competitors, for example by increasing credit provision and charging switching costs (e.g., Lam et al., 2004). Customer retention programmes and greater credit provision not only enhance existing customer relationships but also attract new customers. These developments typically lead to an increase in profits and enhance suppliers' financial ability to undertake more investment opportunities. However, because high credit provision potentially increases default risk and decreases collectability, it can result in financial loss. In addition, diverting resources to enhance customer satisfaction and customer loyalty can reduce suppliers' financial ability to undertake other investment opportunities. We, therefore, examine to what extent customer concentration influences suppliers' willingness to make risky investments in an environment with high (low) competition.

Following Randoy and Jenssen (2004), we measure industry competition levels by industry profit, calculated as the industry-year average profit before interest and taxes, scaled by sales. We then divide our sample into two sub-samples each year, *H_Compt* and *L_Compt*, where *H_Compt* (*L_Compt*) contains observations in more (less) competitive industries, i.e. those with an industry profit margin (which is the same for all firms in a given industry and year) lower (higher) than the median industry profit margin for that year (which is the same for all industries in a given year). We apply equation (3) to both samples. The results in column (3) of Table 6 show that, in highly competitive industries, customer concentration is negatively associated with corporate risk-taking, supporting the view that suppliers operating in a highly competitive environment tend to divert more resources to maintaining and enhancing customer relationships, a practice that limits their ability to undertake other risky investments. The results in column (4) show that, in less competitive industries, suppliers are less concerned about losing customers to competitors, and thus the relationship between customer concentration and corporate risk-taking is not significant. We are not surprised to find that the results presented in columns (3) and (4) of Table 6 are qualitatively similar to those presented in columns (1) and column (2), given that greater marketization leads to greater competition. However, because the marketization setting is broader and contains more dimensions than

competitiveness within an industry does, our results provide insights that advance our understanding of the relationship between customer concentration and corporate risk-taking in different settings at different levels.

5.1.3 Market share

Market share refers to the ratio of a company's sales to the sales of all similar products in the market, and is an important reflection of the company's status and market power. The continuous expansion of enterprises' market share can enable them to obtain some forms of monopoly, which can not only bring monopoly profits but also allow them to maintain certain advantages in competition with other enterprises (e.g., Edeling and Himme, 2018). Prior literature (e.g., Demsetz, 1973; Gale, 1972; Jacobson and Aaker, 1985) indicates that higher-market-share firms benefit from experience curve effects and economies of scale as well as scope, which enable them to reduce costs, with the cost advantages in turn acting as a barrier to new competitors. Therefore, these suppliers' dependence on major customers will be reduced. In addition, firms with high market shares have significantly higher profit margins and operating performance than firms with low market share (e.g., Chowdhury et al., 2017). Suppliers with a high market share are more capable of alleviating the risk of losing large customers. Thus, they may have less need or incentive to reduce their risk-taking. On the other hand, suppliers with a low market share are more dependent on large customers. They will usually need to increase credit provision to strengthen cooperative relationships with major customers (e.g., Lam et al., 2004). Therefore, we expect that firms with a low market share will be more sensitive to the risk embedded in customer-base concentration than those with a higher market share, and will tend to make more conservative investment decisions.

Based on the prior literature (e.g., Edeling and Himme, 2018), we use suppliers' market share to measure their market power, defined as the ratio of their sales to the total sales of all firms in the same industry. We then divide our sample into two sub-samples each year: *H_MS*, with an annual market share higher than the median industry-year market share, and *L_MS*, with an annual market share lower than the median industry-year market share. The results are presented in columns (5) and (6) of Table 6 and show that customer concentration is only negatively and statistically related to a supplier's risk-taking when its market share is below the industry median. This finding suggests that firms with less market power tend to undertake less risky investment activities to reduce the potential negative impacts of a concentrated customer base.

5.1.4 Innovation

In this study, we further examine the premise that the firm-level difference of being a more innovative supplier provides such firms with a comparative advantage, when it comes to retaining customers, over their less innovative counterparts. Prior research shows that competing solely on price and delivery is not the only ingredient of a successful business (e.g., Shaw and Ivens, 2002). Instead, differentiating products and services and delivering unique customer experiences can distinguish a supplier from others. The differentiators strengthen customer loyalty (e.g., Mascarenhas, Kesavan and Bernacchi, 2006) and increase the financial and other costs to customers of switching suppliers (e.g., Cunat, 2007; Giannetti et al., 2011). Various researchers (e.g., Lee and Miller, 1999; Miller, 1986) have proposed innovation as one of the differentiation strategies. We, therefore, predict that, because highly innovative suppliers usually provide greater differentiation and uniqueness in their products and services than their less innovative counterparts, they will be more likely to enjoy higher customer loyalty, remain constantly and even become increasingly attractive to their existing and potential customers, expend less effort and money on purely retaining existing customers and, as a consequence of these attributes, be less likely to see their investment activities affected by customer concentration. Conversely, because suppliers with low innovation provide more undifferentiated products and services, their customers may feel indifferent about switching to other similar suppliers, or be motivated to move to a more innovative supplier. Less innovative firms are also more open to risks associated with losing major customers to competitors, and are thus likely to hold more liquid assets and engage less in risky investment. We therefore predict that suppliers with lower innovation will put more effort than their more innovative counterparts into maintaining their existing customer relationships by undertaking less risky investment.

We use the measure *Patent*, calculated as the natural logarithm of the number of patents of a firm, to categorize our sample of observations into two sub-samples each year: *H_Innova*, where the number of patents is higher than the industry-year median number of patents, and *L_Innova*, where the number of patents is lower than the industry-year median number of patents[12]. The estimation results based on the two sub-samples are reported in columns (7) and (8) of Table 6, and the coefficient of *Customer* is only significantly negative in the *L_Innova*

[12] Our results are also robust to using different thresholds to partition firms, namely dividing our full sample into three sub-samples each year using the 33% and 66% quantiles of the provincial marketization index, industry profit margin, suppliers' market share in each industry, and level of innovation in each industry. We then drop the middle group and apply equation (3) to the upper and lower groups.

group. Consistent with our prediction, therefore, the risk-taking behaviour of suppliers with greater innovation is not significantly affected by changes in customer concentration, whereas suppliers with lower innovation, which will usually be more concerned about losing customers to competitors, tend to keep low-risk profiles.

5.1.5 State-owned suppliers

The tests in this section are aimed at examining the main relationship of this paper, based on the ownership types of the suppliers. We argue that, in the Chinese setting, state-owned suppliers have easier access to finance and other resources than non-state-owned suppliers, and will thus be less financially constrained and less sensitive to variations in their customer base.

Suppliers with government financial support will deem the government to be a more important and powerful stakeholder than their customers, and will thus less likely feel threatened by situations in which major customers walk away or go into liquidation. Furthermore, state-owned suppliers are guaranteed by the power and connections of the government to have additional resources, and are viewed by customers as having more advantages than non-state-owned suppliers. For example, their state-owned nature means they are more likely to secure long-term customers and thus recurring revenues, and such suppliers are considered more reliable than non-state-owned suppliers, due to a lower possibility of bankruptcy. They also benefit from policy information, concessions, and the government's connections and control over scarce resources, which may in turn benefit their customers (e.g., Banerjee et al., 2008; Chen et al., 2014; Musacchio and Lazzarini, 2014). We therefore predict that state-owned suppliers' customer concentration base will have less (or no) impact on their risk-taking behaviours. On the contrary, as non-state-owned suppliers have less financial and other support from the government, we predict that such suppliers' investment decisions will be more sensitive to changes in their customer base. To test our prediction, we categorize our sample of observations into two sub-samples, *State=1,* where suppliers are state-owned firms, and *State=0* where suppliers are non-state-owned firms, and apply equation (3) to the two sub-samples. The results, presented in columns (7) and (8) of Table 6, are consistent with our predictions. They show that the risk-taking activities of state-owned suppliers are not significantly affected by their customer-base concentration, whereas non-state-owned suppliers, which are more concerned about losing customers, make investment decisions in accordance with variations in their customer concentration.

[*Insert Table 6 about here*]

5.1.6 Government and state-owned major customers

In contrast to non-state-owned customers, government or state-owned customers generally have a lower probability of experiencing financial distress and going bankrupt, and also tend to engage in long-term contracts and stable relationships with suppliers. Such attributes mitigate suppliers' cash flow risks and strengthen their financial ability to take investment opportunities (Banerjee et al., 2008; Huang et al., 2016). The reduced cash flow risks are evidenced by a lower cost of equity capital among suppliers with large government and state-owned major customers (Dhaliwal et al., 2016). The lower cost of equity capital is owing to a certification effect provided by such major customers, which are able to monitor suppliers' operating activities and help distressed firms stay afloat (Banerjee et al., 2008; Huang et al., 2016). Further, Banerjee et al. (2008) argue that, since government agents mainly focus on the price and quality of goods and services rather than suppliers' financial profile, their suppliers do not have the same pressure to reduce their leverage or risky investments to maintain a lower risk profile, or to restrict their activities to stay lower risk. We therefore predict that suppliers with government or state-owned major customers will have less need or incentive to reduce their risk-taking, whereas suppliers without such customers will be more cautious with their risk-taking in light of their customer base. To test our prediction, we conduct four sets of two tests each. In the first set of tests, we divide the full sample into a $Gov\_top_{1\_1}$ sub-sample, which contains observations whose largest customer is a government customer, and a $Gov\_top_{1\_0}$ sub-sample, which contains all the other observations. The results are presented in columns (1) and (2) of Table 7, respectively. The results presented in columns (3) and (4) of Table 7 are generated by the second set of tests, in which we divide the full sample into a $Gov\_all_{\_1}$ sub-sample, which contains observations of suppliers with at least one government customer among its top five customers, and a $Gov\_all_{\_0}$ sub-sample that contains all other observations. Columns (5) and (6) of Table 7 report the results generated by the sub-samples $SOEtop_{1\_1}$ and $SOEtop_{1\_0}$, where $SOEtop_{1\_1}$ is a sub-sample including observations of suppliers whose largest customer is state-owned (government agencies are also included), and $SOEtop_{1\_0}$ is a sub-sample including all other observations. Similarly, columns (7) and (8) of Table 7 report the results generated by the sub-samples $SOEall_{\_1}$ and $SOEall_{\_0}$, where $SOEall_{\_1}$ represents observations of suppliers with at least one state-owned customer among their top five customers, and $SOEall_{\_0}$ represents all other observations. The results support our expectations and show that the negative relationship between customer concentration and risk-

taking is only significant for suppliers who have no government or state-owned customers among their five largest customers.

[*Insert Table 7 about here*]

5.2 Threshold tests

We have documented that a firm with a concentrated customer base tends to engage in less risk-taking activities. However, the potential risk embedded in the customer base is likely to depend on the degree of customer concentration. Suppliers may not be subject to cash flow uncertainties caused by losing one or two big customers which contribute a relatively small proportion of total sales. In such situations, they may be more risk-tolerant and more active in taking opportunities to grow and accelerate their development, and customers' preference for suppliers with a low-risk profile will not be reflected in those suppliers' risk-taking decisions. Therefore, we predict that there will be threshold effects in the relationship between customer concentration and suppliers' risk-taking. That is, there will exist some thresholds (or cut-off points) below which customer concentration encourages corporate risk-taking, and beyond which customer concentration has no influence on or reduces corporate risk-taking. The thresholds will reflect customers' power and influence over the suppliers. To test whether threshold effects exist in the relationship between customer concentration and corporate risk-taking, we follow Hansen (1999) and develop the following panel threshold regression model:

$$\begin{aligned} RiskT_{it} = {} & \beta_i + \beta_{11} Customer_{it} I(Customer_{it} \le \theta) + \beta_{12} Customer_{it} I(Customer_{it} > \theta) \\ & + \kappa' Control_{it} + \xi_{it} \end{aligned} \tag{4}$$

Here, customer concentration, *Customer*, is both the independent variable and the threshold variable. Equation (4) captures one threshold effect and divides observations into two groups based on whether the threshold variable, *Customer*, is less than or equal to (i.e., low customer concentration) or above (i.e., high customer concentration) the yet unknown threshold value θ, which is estimated by the least-squares approach (e.g., Chan, 1993; Hansen, 1999). $I(\cdot)$ is the indicator function. The two groups are distinguished by the relationship between customer concentration and corporate risk-taking, determined by the sign and significance of β_{11} and β_{12}. For any given θ, a β can be estimated by ordinary least squares. The θ that yields the lowest sum of squared errors, $S_1(\theta)=e_i(\theta)' e_i(\theta)$, is the estimated threshold value, θ^*. A

bootstrap method is used to assess the statistical significance of the threshold effect because it generates the first-order asymptotic distribution and valid *p*-values (Hansen, 1996).

If two thresholds exist, they can be built into the model in the same way:

$$RiskT_{it} = \gamma_i + \gamma_{11} Customer_{it} I(Customer_{it} \le \theta_1) + \gamma_{12} Customer_{it} I(\theta_1 < Customer_{it} \le \theta_2) + \gamma_{13} Customer_{it} I(Customer_{it} > \theta_2) + \pi' Control_{it} + \upsilon_{it} \quad (5)$$

In equation (4), if β_{11} is significantly positive and β_{12} is significantly negative, it will mean there is at least one threshold in the relationship between customer concentration and suppliers' risk-taking. In equation (5), if γ_{13} is significantly negative, while either γ_{11} or γ_{12} is significantly positive and γ_{11} is not negative, it will mean there are two thresholds in the relationship. Using a threshold model to split samples into different groups addresses concerns about splitting a sample on an ad hoc basis (Hansen, 1999).

We regress the customer concentration measures, *Customer* and *HHI*, on the five corporate risk-taking proxies, namely, ROA *volatility*, *Z-score*, *Leverage, R&D* and *Overinvest,* based on the threshold regression model. Table 8 presents the results of the threshold regression models. [13] We use a bootstrap procedure to determine either the lack of a threshold or the existence of a single threshold or multiple thresholds. The threshold values are reported in the notes of Table 8. The results in column (1) show that the existence of a positive association between customer concentration (i.e., the ratio of aggregate sales to the top five customers of a supplier, to the supplier's total sales) and corporate risk-taking, for those firms whose customer concentration is less than or equal to 9.1%.[14] The results suggest that, instead of posing a substantial risk to a firm, a lower level of customer concentration is more likely to provide suppliers with stable cash inflows and investment opportunities. When customer concentration is between 9.1% and 27.3%, firms recognise the potential risks embedded in their customer base, and become more conservative or risk-neutral in their investment. However, firms with a customer concentration above 27.3% are likely to reduce their risk-taking activities, and are more inclined to take precautionary measures and avoid risky investments. The results verify the regulators' neglect of any risk from the customer base when suppliers spread their revenues across a portfolio of customers, and their concerns about risks posed by major

[13] Panel threshold regression can only be used for balanced panel data. Therefore, we transform our unbalanced panel data into balanced panel data. This transformation significantly reduce number of observations in the sample. Balancing our data using the main proxies for customer concentration and corporate risk-taking results in 1,728 balanced panel data observations.

[14] After applying 500 bootstrap replications, untabulated highly significant F-value of 7.716 and bootstrap p-value of 0.028 indicate the presence of two thresholds in the relation between *Customer* and *ROA volatility.* The threshold values are 9.1% and 27.3%, respectively.

customers to whom a significant proportion of sales are made. They are also in line with our main results, confirming that a highly concentrated customer base restrains suppliers' risk-taking. The results are presented in columns (2) - (10) and show a pattern consistent with the previous case, i.e. that the relationship is positive for low customer concentration but turns negative for high customer concentration. Specifically, the results in column (2) show that *HHI* is positively associated with corporate risk-taking when *HHI* is less than or equal to 0.248. However, firms with concentrated customer bases (i.e. an *HHI* greater than 0.248) are likely to reduce their risk-taking activities. In columns (3), (4) and (6), we observe that *Customer* (*HHI*) is positively and significantly related to *Z-score* (*Leverage*) for those firms whose *Customer* (*HHI*) is less than or equal to 10.3% (0.063 or 0.043). However, we find a significant and negative relation when *Customer* (*HHI*) is above 25.0% (0.161 or 0.12), suggesting that highly customer-concentrated firms are willing to reduce their risk-taking behaviour. In column (5), we also observe a significantly positive relation between *Customer* and *Leverage* when *Customer* is below 26.5% However, the coefficient on *Customer_1* is less positive than the coefficient on *Customer_2,* suggesting that the positive impact becomes weaker as the customer concentration increases. The relation turns negative when *Customer* further increases above 26.5%. The results from columns (7) - (10) also confirm the existence of threshold effects in the relationship between customer concentration and corporate risk-taking, measured by *R&D* and *Overinvest*.

[*Insert Table 8 about here*]

6. Conclusion

Because corporate risk-taking and investment decisions directly affect firm profitability and future prospects, it is important to understand the factors that influence corporate risk-taking. In this study, we examine how a firm's customer base, a powerful stakeholder towards which firms most need to direct their efforts, influences corporate risk-taking. We find that, in general, high customer concentration deters corporate risk-taking. This finding is consistent with the view that firms' greater demand for liquid assets and their lack of incentive to commit resources to risk-taking is due to their consideration of the need to buffer themselves against the negative consequences of losing major customers. In addition, in order to maintain their existing relationships with major customers, suppliers are likely to reduce their risk-taking to minimize their financial uncertainty, because their customers are reluctant to establish long-term

relationships with financially uncertain suppliers. The results are robust to controlling for endogeneity, and to using alternative proxies for customer concentration and corporate risk-taking.

We also conduct additional tests to explore whether different settings affect this established relationship, and find that the deterring effects of customer concentration on corporate risk-taking only exist for suppliers operating in more marketized regions or more competitive industries, with less market share, that innovate less and that are not owned by the state. These results suggest that firms in more marketized regions, in more competitive industries, with less market shares, that innovate less, and that receive limited support from the government, dedicate more resources and efforts towards maintaining or improving their relationships with their major customers, which restricts their risk-taking activities. Furthermore, we investigate the effect of having government or state-owned major customers on risk-taking, and find that the negative relationship between customer concentration and risk-taking is only significant for suppliers which do not have major government or state-owned customers. Finally, considering the benefits gained from having major customers and the regulators' view of the risks embedded in the customer base, we test the threshold effects in the relationship between customer concentration and corporate risk-taking. We find that there exists a threshold below which customer concentration encourages corporate risk-taking, and another one beyond which customer concentration reduces corporate risk-taking, with no effect between the two points. Our threshold test results justify the regulators' neglect of risks from the customer base when suppliers spread their revenues across a portfolio of customers, and their concerns about the risks posed by major customers to which a significant proportion of sales are made. The findings are in line with our main results, confirming that a highly concentrated customer base restrains suppliers' risk-taking.

Our findings have broad implications for both Chinese policy makers and corporate managers and those from other emerging markets around the world, by providing evidence of the direct relevance of firms' customer-base concentration to their investment decision-making process. Corporate risk-taking has important implications for firm growth, performance and survival (Shapria, 1995). Our findings indicate that firms with concentrated customer bases are more likely to be conservative in their investment, rather than searching for new capabilities through R&D. To encourage investment at the firm level, especially for firms with highly concentrated customer bases, and hence innovation and overall growth, governments need to undertake the necessary measures to promote competition in markets and industries, and better

enforce contracts, thus reducing customer concentration. Moreover, strong investor protection and law enforcement need to be put in place to improve the investment environment of firms. Furthermore, governments can provide investment grants, subsidies or tax incentives to encourage new product development and innovation. The government support would increase certainty and reduce investment risks. Another important implication here is that firms could engage in more product co-development and information-sharing with their major customers. These collaborations would not only strengthen the supplier-customer relationships but also provide a risk-sharing mechanism and increase product innovation.

References

Acharya, V.V., Amihud, Y., Litov, L., 2011. Creditor rights and corporate risk-taking. J. Financ. Econ. 102(1), 150-166.

Acemoglu, D., Zilibotti, F., 1999. Information accumulation in development. J. Econ. Growth 4(1), 5-38.

Ambrus, A., Mobius, M., Szeidl, A., 2014. Consumption risk-sharing in social networks. Am. Econ. Rev. 104(1), 149-182.

Anthony, J.H., Ramesh, K., 1992. Association between accounting performance measures and stock prices: A test of the life cycle hypothesis. J. Account. Econ. 15(2), 203-227.

Balakrishnan, R., Linsmeier, T., Venkatachalam, M., 1996. Financial benefits from JIT adoption: effects of customer concentration and cost structure. Account. Rev. 71(2), 183-205.

Banerjee, S., Dasgupta, S., Kim, Y., 2008. Buyer-supplier relationships and the stakeholder theory of capital structure. J. Financ. 63(5), 2507-2552.

Bargeron, L.L., Lehn, K.M., Zutter, C.J., 2010. Sarbanes-Oxley and corporate risk-taking. J. Account. Econ. 49(1), 34-52.

Barroso, C., Picón, A., 2012. Multi-dimensional analysis of perceived switching costs. Ind. Market. Manag. 41(3), 531-543.

Boubakri, N., Cosset, J.C., Saffar, W., 2013. The role of state and foreign owners in corporate risk-taking: evidence from privatization. J. Financ. Econ. 108(3), 641-658.

Bradbury, M.E., Ma, D., Scott, T., 2019. Explanations for not having an audit committee in a 'comply or explain' regime. Aust. Account. Rev. 29(4), 649-662.

Cain, M.D., Mckeon, S.B., 2016. CEO personal risk-taking and corporate policies. J. Financ. Quant. Anal. 51(1), 139-164.

Campello, M., Gao, J., 2017. Customer concentration and loan contract terms. J. Financ. Econ. 123(1), 108-136.

Campello, M., Hackbarth, D., 2012. The firm-level credit multiplier. J. Financ. Intermed. 21(3), 446-472.

Cen, L., Maydew, E.L., Zhang, L., Zuo, L., 2017. Customer-supplier relationships and corporate tax avoidance. J. Financ. Econ. 123(2), 377-394.

Chen, G., Zenglein, M., 2019. The global faces of China's incomplete reforms: a perspective from China's new intellectual property regime. J. Chines. Econ. Bus. Stud. 17(4), 425-443.

Chen, S., Chen, X., Cheng, Q., Shevlin, T., 2010. Are family firms more tax aggressive than non-family firms? J. Financ. Econ. 95(1), 41-61.

Chevalier, J., Goolsbee, A., 2009. Are durable goods consumers forward looking? Evidence from college textbooks. Q. J. Econ. 124(4), 1853-1884.

Chipty, T., Snyder, C.M., 1999. The role of firm size in bilateral bargaining: a study of the cable television industry. Rev. Econ. Stat. 81(2), 326-340.

Chyz, J.A., Ching, W.S., Zhen L.O., Meng, R.O., 2013. Labor unions and tax aggressiveness. J. Financ. Econ. 108(3), 675-698.

Cohen, L., Frazzini, A., 2008. Economic links and predictable returns. J. Financ. 63(4), 1977-2011.

Coles, J.L., Daniel, N.D., Naveen, L., 2006. Managerial incentives and risk-taking. J. Financ. Econ. 79(2), 431-468.

Cunat, V., 2007. Trade credit: suppliers as debt collectors and insurance providers. Rev. Financ. Stud. 20(2), 491-527.

Deloof, M., 2003. Does working capital management affect profitability of Belgian firms? J. Bus. Finan. Account. 30(3), 573-588.

Dhaliwal, D., Judd, J.S., Serfling, M., Shaikh, S., 2016. Customer concentration risk and the cost of equity capital. J. Account. Econ. 61(1), 23-48.

Dong, Y.Z., Meng, C., Firth, M., Hou, W.X., 2014. Ownership structure and risk-taking: Comparative evidence from private and state-controlled banks in China. Int. Rev. Financ. Anal. 36,120-130.

Ellis, J., Fee, C., Thomas, S., 2012. Proprietary costs and the disclosure of information about customers. J. Account. Res. 50, 685-727.

Edeling, A., Himme, 2018. When does market share matter? New empirical generalizations from a Meta-Analysis of the market share-performance relationship. J. Marketing 82(3), 1-24.

Faccio, M., Marchica, M., Mura, R., 2011. Large shareholder diversification and corporate risk-taking. Rev. Financ. Stud. 24(11), 3601-3641.

Faccio, M., Marchica, M.T., Mura, R., 2016. CEO gender, corporate risk-taking, and the efficiency of capital allocation. J. Corp. Financ. 39, 193-209.

Fee, C.E., Thomas, S., 2004. Sources of gains in horizontal mergers: evidence from customer, supplier, and rival firms. J. Financ. Econ. 74(3), 423-460.

Ferris, S.P., Javakhadze, D., Rajkovic, T., 2017. CEO social capital, risk-taking and corporate policies. J. Corp. Financ. 47, 46-71.

Fogel, K., Morck, R., Yeung, B., 2008. Big business stability and economic growth: Is what's good for General Motors good for America? J. Financ. Econ. 89(1), 83-108.

Giannetti, M., Burkart, M., Ellingsen, T., 2011. What you sell is what you lend? Explaining trade credit contracts. Rev. Financ. Stud. 24(4), 1261-1298.

Gosman, M., Kelly, T., Olsson, P., Warfield, T., 2004. The profitability and pricing of major customers. Rev. Account. Stud. 9(1), 117-139.

Habib, A., Hasan, M., 2017. Firm life cycle, corporate risk-taking and investor sentiment. Account. Financ. 57(2), 465-497.

Hansen, B.E., 1996. Inference when a nuisance parameter is not identified under the null hypothesis. Econometrica 64(2), 413-430.

Hansen, B.E., 1999. Threshold effects in non-dynamic panels: estimation, testing and inference. J. Econometrics 93(2), 345-368.

Hasan, Hoi, C.K., Wu, Q., Zhang, H., 2017. Does social capital matter in corporate decisions? Evidence from corporate tax avoidance. J. Account. Res. 55(3), 629-668.

Hertzel, M.G., Li, Z., Officer, M.S., Rodgers, K.J., 2008. Inter-firm linkages and the wealth effects of financial distress along the supply chain. J. Financ. Econ. 87(2), 374-387.

Huang, H.H., Lobo, G.J., Wang, C., Xie, H., 2016. Customer concentration and corporate tax avoidance. J. Bank. Financ. 72, 184-200.

Irvine, P.J., Park, S.S., Yildizhan, C., 2016. Customer-base concentration, profitability, and the relationship life cycle. Account. Rev. 91(3), 883-906.

Itzkowitz, J., 2013. Customers and cash: how relationships affect suppliers' cash holdings. J. Corp. Financ. 19(1), 159-180.

Itzkowitz, J., 2015. Buyers as stakeholders: how relationships affect suppliers' financial constraints. J. Corp. Financ. 31, 54-66.

John, K., Litov, L., Yeung, B., 2008. Corporate governance and risk-taking. J. Financ. 63(4), 1679-1728.

Johnson, W.C., Kang, J.K., Yi, S., 2010. The certification role of large customers in the new issues market. Financial management. 39, 1425-1474.

Kale, J.R., Shahrur, H., 2007. Corporate capital structure and the characteristics of supplier and customer markets. J. Financ. Econ. 83, 321-365.

Kalwani, M.U., Narayandas, N., 1995. Long-term manufacturer-supplier relationships: do they pay off for supplier firms? J. Marketing 59(1), 1-16.

Kim, Y.H., Wemmerlov, U., 2015. Does a suppliers' operational competence translate into financial performance? An empirical analysis of supplier-customer relationships. Decision Sci. 46(1), 101-134.

Kini, O., Williams, R., 2012. Tournament incentives, firm risk, and corporate policies. J. Financ. Econ. 103(2), 350-376.

Kinney, M.R., Wempe, W.F., 2002. Further evidence on the extent and origins of JIT's profitability effects. Account. Rev. 77 (1), 203-225.

Kolay, M., Lemmon, M., Tashjian, E., 2016. Spreading the misery? Sources of bankruptcy spillover in the supply chain. J. Financ. Quant. Anal. 51(6), 1955-1990.

Korcan, A.B., Patatoukas, P.N., 2016. Customer-Base Concentration and Inventory Efficiencies: Evidence from the Manufacturing Sector. Prod. Oper. Manag. 25(2), 258-272.

Kothari, S.P., 2001. Capital markets research in accounting. J. Account. Econ. 31(3), 105-231.

Krolikowski, M., Yuan, X., 2017. Friend or foe: Customer-supplier relationships and innovation. J. Bus. Res. 78, 53-68.

Kumar, N., 1996. The power of trust in manufacturer retailer relationship. Harvard Busin. Rev. 74 (6), 92-106.

Kusnadi, Y., 2015. Insider trading restrictions and corporate risk-taking. Pac-Basin. Financ. J. 35, 125-142.

Lam, S.Y., Shankar, V., Erramilli, M.K., Murthy, B., 2004. Customer value, satisfaction, loyalty, and switching costs: an illustration from a business-to-business service context. J. Acad. Market. Sci. 32(3), 293-311.

Larcker, D.F., Rusticus, T.O., 2010. On the use of instrumental variables in accounting research. J. Account. Econ. 49(3), 186-205.

Lee, J., Miller, D., 1999. People matter: commitment to employees, strategy and performance in Korean firms. Strategic. Manage. J. 20(6), 579-593.

Li, K., Griffin, D., Yue, H., Zhao, L., 2013. How does culture influence corporate risk-taking? J. Corp. Financ. 23(4), 1-22.

Maksimovic, V., Titman, S., 1991. Financial policy and a firm's reputation for product quality. Rev. Financ. Stud. 4(1), 175-200.

Massa, M., Zhang, B., Zhang, H., 2015. The invisible hand of short selling: does short selling discipline earnings management? Rev. Financ. Stud. 28(6), 1701-1736.

Matzler, K., Strobl, A., Thurner, N., Füller, J., 2015. Switching experience, customer satisfaction, and switching costs in the ICT industry. J. Serv. Manage. 26(1), 117-136.

Mascarenhas, O.A., Kesavan, R., Bernacchi, M., 2006. Lasting customer loyalty: a total customer experience approach. J. Consum. Marketing 23(7), 397-405.

Miller, D., 1986. Configurations of strategy and structure: towards a synthesis. Strategic. Manage. J. 7, 233-249.

Murfin, J., Njoroge, K., 2015. The implicit costs of trade credit borrowing by large firms. Rev. Financ. Stud. 28(1), 112-145.

Musacchio, A. Lazzarini, S.G., 2014. Reinventing State Capitalism: Leviathan in Business, Brazil and Beyond, Cambridge, MA and London, England: Harvard University Press.

Nakano, M., Nguyen, P., 2012. Board size and corporate risk taking: further evidence from Japan. Corp. Gov-Oxford. 20(4), 369-387.

Norden, L., Kampen, S.V., 2013. Corporate leverage and the collateral channel. J. Bank. Financ. 37(12), 5062-5072.

Pan, J., Yu, M., Liu, J. and Fan, R., 2020. Customer concentration and corporate innovation: Evidence from China. North American J. of Econ. Financ. (54), 101284.

Patatoukas, P.N., 2012. Customer-base concentration: implications for firm performance and capital markets. Account. Rev. 87(2), 363-392.

Pedersen, E.R., Andersen, M., 2006. Safeguarding corporate social responsibility (CSR) in global supply chains: how codes of conduct are managed in buyer supplier relationships. J. Public. Aff. 6(3), 228-240.

Perez-Quiros, G., Timmermann, A., 2000. Firm size and cyclical variations in stock returns. J. Financ. 55(3), 1229-1262.

Petersen, M.A., Rajan, R.G., 1997. Trade credit: theories and evidence. Rev. Financ. Stud. 10(3), 661-691.

Pfarrer, M.D., Pollock, T.G., Rindova, V.P., 2010. A tale of two assets: the effects of firm reputation and celebrity on earnings surprises and investors' reactions. Acad. Manage. J. 53(5), 1131-1152.

Raman, K., Shahrur, H., 2008. Relationship-specific investments and earnings management: evidence on corporate suppliers and customers. Account. Rev. 83(4), 1041-1081.

Randoy, T., Jenssen, J.I., 2004. Board independence and product market competition in Swedish firms. Corp. Gov-Oxford. 12(3), 281-289.

Richardson, S., 2006. Over-investment of free cash flow. Rev. Account. Stud. 11(2), 159-189.

Rosenbaum, P.R., Rubin, D.B., 1983. The central role of the propensity score in observational studies for causal effects. Biometrika, 70(1), 41-55.

Saboo, A.R., Kumar, V., Anand, A., 2017. Assessing the impact of customer concentration on initial public offering and balance sheet-based outcomes. J. Marketing 81(6), 42-61.

Shaw, C., Ivens, J., 2002. Building Great Customer Experiences. Palgrave Macmillan, Basingstoke.

Stock, J.H., Yogo, M., 2005. Testing for weak instruments in linear IV regression. In Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg. Cambridge University Press, 80-108.

Titman, S., 1984. The effect of capital structure on a firm's liquidation decision. J. Financ. Econ. 13(1), 137-151.

Titman, S., Wessels, R., 1988. The determinants of capital structure and choice. J. Financ. 43(1), 1-40.

Wang, J., 2012. Do firms' relationships with principal customers/suppliers affect share holders' income. J. Corp. Financ. 18(4), 860-878.

White, G.P., 1996. A meta-analysis model of manufacturing capabilities. J. Oper. Manag. 14(4), 315-331.

World Bank, 2017. World Development Indicators. World Bank, Washington DC.

Wurgler, J., 2000. Financial markets and the allocation of capital. J. Financ. Econ. 58(1), 187-214.

Appendix A Variable definitions

Variables of interest

Customer	Customer concentration, measured by the aggregate sales to the top five customers scaled by the supplier's total sales.
HHI	Customer concentration Herfindahl-Hirschman index, measured by the sum of squared sales to the top five customers scaled by the supplier's total sales. $CustomerHHI = \sum_{i=1}^{5} P_i$, where P is the sales to the customer scaled by the supplier's total sales.
RiskT	Corporate risk-taking, measured by the volatility of a firm's *ROA* over a given three-year overlapping period, and *ROA* here is industry-adjusted each year by the subtraction of the sample-wide mean *ROA* for the firm's industry.
Z-score	Z-score= -[0.012×(working capital / total assets)+0.014×(retained earnings / total assets)+0.033×(earnings before interest and taxes / total assets)+0.006×(market value of equity / book value of total liabilities)+ 0.999×(sales / total assets)]
Leverage	The leverage ratio, calculated as total debt divided by total assets.
R&D	The ratio of R&D expenditure to operating income
Overinvest	An indicator variable taking the value of one when the residual of the investment expectation model is positive, and zero otherwise. Following Richardson (2006), the investment expectation model is estimated as $Inv_{i,t} = \beta_0 + \beta_1 Tobinq_{i,t-1} + \beta_2 Size_{i,t-1} + \beta_3 Leverage_{i,t-1} + \beta_4 Age_{i,t-1} + \beta_5 Cash_{i,t-1} + \beta_6 Ret_{i,t-1} + \beta_7 Inv_{i,t-1} + \sum Industry + \sum year + \varepsilon_{i,t}$

Other variables

Asset	Total assets of firms.
Size	Firm size, measured as the natural logarithm of total assets.
Tangibility	Fixed assets scaled by total assets.
Intangibility	Net intangible assets scaled by total assets.
ROA	Return on assets, calculated as net profit divided by total assets.
Eqinc	Equity income scaled by total assets.
BM	Book-to-market ratio.
Growth	The growth in sales revenue from year t-1 to year t divided by the revenue in year t-1.
Cash flow rights	The ownership rights of the largest ultimate shareholder.
PayTurn	Trade payables turnover, calculated as average trade payables divided by credit purchase.
State	Indicator variable: equals one if the firm is under state control, otherwise zero.
Ind_cust	Instrumental variable, defined as the one-period-lagged industry-year median customer concentration.
H_Mkt, L_Mkt	We use the provincial marketization index designed by Fan et al. (2017) to measure the level of marketization in China's provinces. We categorize firms located in provinces with an annual marketization index higher (lower) than the annual median marketization index as the more (less) marketized group.
H_Compt, L_Compt	We measure industry competition levels by industry profit calculated as the industry-year average profit before interest and taxes scaled by the sales. We then divide our sample into two sub-samples each year, H_Compt and L_Compt, where H_Compt (L_Compt) contains observations in more (less) competitive industries with an industry profit margin (which is the same for all firms in the same industry and year) lower (higher) than the median industry profit margin that year (which is the same for all industries in that year).
H_MS, L_MS	We use suppliers' market share to measure their market power, defined as the ratio of their sales to the total sales of all firms in the same industry. H_MS are those firms whose annual market share is higher than the industry-year median market share, and L_MS are those whose annual market share is lower than the industry-year median.
H_Innova, L_Innova	We use the natural logarithm of the number of patents of a firm to categorize our sample of observations into two sub-samples each year: H_Innova contains those firms for which this variable is higher than the industry-year median, and L_Innova those for which it is lower.
Gov_top	$Gov\_top_{1\_1}$ represents those suppliers whose largest customer is a government agency (e.g., public school, research institution, public hospital, government department, etc.). $Gov\_top_{1\_0}$ represents those whose largest customer is not a government agency.
Gov_all	$Gov\_all_{\_1}$ represents suppliers which have at least one government agency among their top five customers, and $Gov\_all_{\_0}$ those with no government agencies among their top five customers.
SOEtop	$SOEtop_{1\_1}$ represents suppliers whose largest customer is a state-owned enterprise (government agencies are also included). $SOEtop_{1\_0}$ represents those whose largest customer is a non-state-owned enterprise.

SOEall	SOEall_1 represents those suppliers with at least one state-owned enterprise among their top five customers (government agencies are also included), and SOEall_0 those with no state-owned enterprise among their top five customers.

Figures

Figure 1. Propensity scores before matching

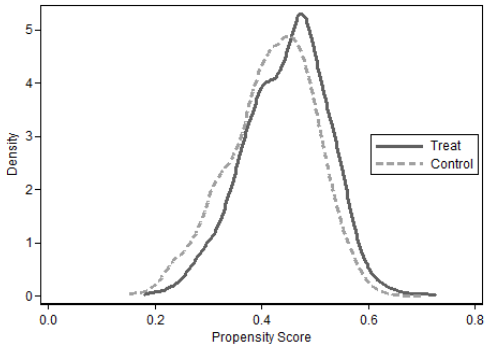
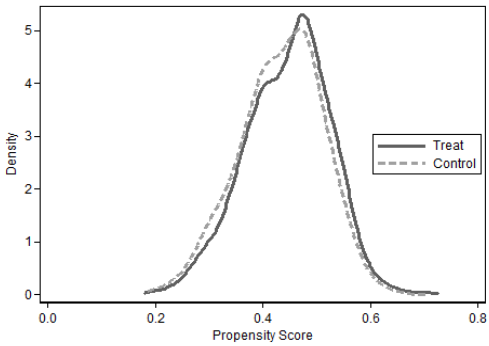


Figure 2. Propensity scores after matching



Tables

Table 1 Descriptive statistics

Variable	N	Mean	SD	Min.	P50	Max.
RiskT	4842	0.101	0.192	0.0002	0.030	1.180
Leverage	4842	0.403	0.216	0.035	0.394	0.854
Z-score	4706	-0.739	0.455	-2.548	-0.636	-0.090
R&D	3001	4.282	4.048	0.040	3.440	24.77
Overinvest	3072	0.378	0.485	0.000	0.000	1.000
Customer	4842	0.302	0.214	0.016	0.244	0.968
HHI	4842	0.043	0.106	0.000	0.000	0.712
Asset (millions)	4842	5,909	12,782	375	2,108	92,719
Size	4842	21.66	1.113	19.74	21.47	25.25
Tangiblity	4842	0.225	0.157	0.004	0.193	0.693
Intang	4842	0.044	0.042	0.000	0.034	0.232
ROA	4842	0.051	0.051	-0.097	0.046	0.226
Eqinc	4842	0.005	0.013	-0.005	0.0003	0.081
BM	4842	0.888	0.811	0.120	0.629	4.728
Growth	4842	0.189	0.348	-0.447	0.136	2.042
Rights	4842	0.363	0.149	0.092	0.350	0.750
PayTurn	4842	0.097	0.142	0.011	0.057	1.089

Notes: This table reports descriptive statistics for the main dependent and independent variables. *RiskT*, *Leverage* and *Z-score* are the measures of corporate risk-taking. *Customer* and *HHI* are the measures of customer concentration. See Appendix A for variable definitions.

Table 2 Customer concentration and corporate risk-taking

RiskT	(1)	(2)	(3)
Customer	-0.118***	-0.101**	-0.103**
	(-2.665)	(-2.375)	(-2.457)
Size		-0.042**	-0.063***
		(-2.561)	(-2.793)
Leverage		0.176***	0.194***
		(3.257)	(3.494)
Tangibility		0.110**	0.104**
		(2.136)	(1.994)
Intang		0.034	-0.005
		(0.143)	(-0.019)
ROA		-0.326*	-0.296
		(-1.718)	(-1.521)
Eqinc		1.301***	1.250**
		(2.661)	(2.539)
BM		0.005	-0.003
		(0.847)	(-0.430)
Growth		0.687	0.744
		(0.787)	(0.838)
Rights		-0.100	-0.057
		(-0.734)	(-0.435)
PayTurn		0.031	0.027
		(0.777)	(0.661)
State		0.026	0.030
		(0.535)	(0.645)
Firm fixed effects	YES	YES	YES
Year fixed effects	NO	NO	YES
Constant	0.136***	0.978**	1.382***
	(10.238)	(2.578)	(2.806)
Observations	4,842	4,842	4,842
R-squared	0.005	0.031	0.035

Notes: This table reports the OLS regression results between the corporate risk-taking proxy, customer concentration measure and a set of control variables. The dependent variable, *RiskT*, is the volatility of a firm's industry-adjusted return on assets (ROA) constructed over three-year overlapping windows. *Customer* is measured by the aggregate sales to the top five customers scaled by the supplier's total sales. All tests include firm fixed effects. The *t*-statistics reported in parentheses are based on standard errors adjusted to be heteroscedasticity robust and clustered at the firm level. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

Table 3 Customer concentration and corporate risk-taking: PSM and IV estimations

Panel A

Variable	Sub-sample	Mean		Standard Deviation %	t-value	p-value
		Treat	Control			
Size	U	21.507	21.783	-25.1	-8.64	0.000
	M	21.508	21.508	-0.4	-0.14	0.888
ROA	U	0.050	0.052	-5.3	-1.81	0.070
	M	0.050	0.051	-2.1	-0.67	0.500
Intang	U	0.043	0.046	-6.5	-2.26	0.024
	M	0.043	0.042	0.8	0.29	0.774
Eqinc	U	0.005	0.005	-2.3	-0.81	0.420
	M	0.005	0.005	1.7	0.59	0.555
Leverage	U	0.383	0.419	-16.8	-5.81	0.000
	M	0.383	0.379	1.8	0.60	0.550
Tangiblity	U	0.227	0.223	2.4	0.84	0.403
	M	0.227	0.227	0.0	-0.01	0.993
Growth	U	0.002	0.002	7.1	2.50	0.012
	M	0.002	0.002	-1.0	-0.31	0.753
PayTurn	U	0.089	0.103	-9.7	-3.33	0.001
	M	0.089	0.090	-0.5	-0.18	0.854

Panel B

	(1)	(2)	(3)	(4)
	PSM	2SLS		
		First stage	Second stage	
Dependent variables	*RiskT*	*Customer*	*RiskT*	*RiskT*
Customer	-0.182***		-0.098**	-0.087*
	(-3.432)		(-2.34)	(-1.662)
Ind_Cust		1.004***		0.044
		(14.00)		(0.563)
Control variables	YES	YES	YES	YES
Firm fixed effects/ year fixed effects	YES	YES	YES	YES
Constant	1.378**	0.656***	0.479***	0.830
	(1.991)	(8.38)	(4.33)	(1.574)
Observations	2,562	3,115	3,115	3,115
R-squared	0.049	0.158	0.061	0.030

Notes: This table reports the results generated by PSM and 2SLS. In Panel A, U means before matching, and M means after matching. Treat denotes the treatment group, and Control the control group. In Panel B, column (1) reports the regression results after propensity score matching. Columns (2) and (3) report the results of the first and second stages of the two-stage regression, respectively. *Ind_Cust,* the instrumental variable, is equal to the lag of the industry-year median customer concentration. The regression result in column (4) is used to test the exclusion restriction of the instrument of customer concentration (i.e., *Ind_Cust*), based on the prior literature (e.g., Hasan et al., 2017). The t-values (in parentheses) are clustered at the firm level and are used to address issues of heteroscedasticity and correlated error terms across firms and/or across time. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. All variables are defined in Appendix A.

Table 4. Robustness test results using other proxies for customer concentration and corporate risk-taking

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RiskT	*Leverage*	*Z-score*	*R&D*	*Overinvest*	*Leverage*	*Z-score*	*R&D*	*Overinvest*
Customer						-0.063**	-0.054**	-1.843***	-0.045**
						(-2.528)	(-1.991)	(-2.689)	(-2.337)
HHI	-0.081**	-0.074***	-0.058*	-1.861**	-0.062***				
	(-2.423)	(-2.731)	(-1.912)	(-2.484)	(-2.790)				
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	1.365***	-1.230***	-2.457***	3.783	1.010***	-1.216***	-2.449***	3.956	1.012***
	(5.489)	(-6.438)	(-11.341)	(0.457)	(6.283)	(-6.304)	(-11.320)	(0.478)	(6.297)
Observations	4,842	4,842	4,706	3,001	3,072	4,842	4,706	3,001	3,072
R-squared	0.033	0.238	0.098	0.108	0.125	0.238	0.096	0.109	0.124

Notes: This table reports the OLS regression results between the corporate risk-taking proxies, customer concentration measures and a set of control variables. Corporate risk-taking, the dependent variable, is captured by five proxies, *RiskT*, *Leverage, Z-score, R&D* and *Overinvest*, respectively. Customer concentration is captured by *Customer* and *HHI*, respectively. The sample includes firms from 2009 to 2015 that have non-missing customer-base concentration measures. The number of observations in some columns is not 4,842 due to missing values of *Z-score, R&D* and *Overinvest*. All regressions include all variables from the baseline regressions and firm and year fixed effects. The *t*-statistics reported in parentheses are based on standard errors that are adjusted to be heteroscedasticity robust and clustered at the firm level. To conserve space, we do not report the coefficient estimates for the control variables. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

Table 5 Analysis of changes in customer-base concentration

Variable	*⊿RiskT*
⊿Customer	-0.0820**
	(-2.047)
Control variables	YES
Year fixed effects	YES
Firm fixed effects	YES
Constant	-0.2985
	(-0.575)
Observations	3,115
R-squared	0.021

Notes: The dependent variable is *⊿RiskT*, defined as the annual change in customer-base concentration. *⊿Customer* is defined as the annual change in suppliers' risk-taking. The *t*-statistics reported in parentheses are based on standard errors adjusted to be heteroscedasticity robust and clustered at the firm level. To conserve space, we do not report the coefficient estimates for the control variables. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 6. Customer concentration and corporate risk-taking: sub-sample analyses

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	H_Mkt	*L_Mkt*	*H_Compt*	*L_Compt*	*H_MS*	*L_MS*	*H_Innova*	*L_Innova*	*State=1*	*State=0*
Customer	-0.128*	-0.074	-0.186***	-0.068	-0.055	-0.126**	-0.081	-0.157***	-0.059	-0.125**
	(-1.787)	(-1.448)	(-3.299)	(-1.188)	(-0.753)	(-2.451)	(-1.076)	(-3.337)	(-1.103)	(-2.290)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	0.369	1.821***	1.328	1.223**	1.347*	-0.057	1.747**	0.304	1.471***	1.585*
	(0.442)	(2.919)	(1.629)	(2.621)	(1.944)	(-0.072)	(2.067)	(0.489)	(2.876)	(2.127)
Observations	2,749	2,093	2,423	2,419	2,403	2,439	2,407	2,435	1,637	3,205
R-squared	0.039	0.063	0.038	0.051	0.039	0.037	0.044	0.046	0.047	0.040
Difference in coefficients of *Customer*	0.054*		0.118***		0.071**		0.076**		0.066**	

Notes: This table reports the regression results for the effect of customer concentration on corporate risk-taking based on sub-samples. All regressions include all variables from the baseline regressions and firm and year fixed effects. The results in columns (1) and (2) are generated using observations in more and less marketized regions, respectively; those in columns (3) and (4) using observations in more and less competitive industries, respectively; those in columns (5) and (6) using observations with higher and lower market shares, respectively; those in columns (7) and (8) using observations with high and low levels of innovation, respectively; and those in columns (9) and (10) using observations of state-owned and non-state-owned suppliers, respectively.The *t*-statistics reported in parentheses are based on standard errors that are adjusted to be heteroscedasticity robust and clustered at the firm level. To conserve space, we do not report the coefficient estimates for the control variables. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

Table 7. Government and SOE customers and corporate risk-taking

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Gov_top1_1	*Gov_top1_0*	*Gov_all_1*	*Gov_all_0*	*SOEtop1_1*	*SOEtop1_0*	*SOEall_1*	*SOEall_0*
Customer	-0.058	-0.150***	0.100	-0.162***	-0.007	-0.231***	-0.059	-0.257***
	(-0.603)	(-3.745)	(0.973)	(-3.819)	(-0.145)	(-4.539)	(-1.310)	(-4.174)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-2.301	1.482***	2.005***	1.660***	0.995*	1.391**	1.161**	1.524*
	(-1.017)	(2.902)	(2.599)	(3.053)	(1.936)	(2.066)	(1.996)	(1.939)
Observations	213	4489	500	4202	1228	3474	1972	2730
R-squared	0.232	0.038	0.100	0.037	0.063	0.044	0.076	0.045
Difference in coefficients of *Customer*	0.092***		0.262***		0.224***		0.198***	

Notes: This table reports the regression results on the effect of customer concentration on corporate risk-taking using sub-samples based on whether a supplier has government or state-owned major customers. *Gov_top1_1* contains observations of suppliers whose largest customer is a government customer, and *Gov_top1_0* contains all other observations. *Gov_all_1* contains observations of suppliers with at least one government customer among their top five customers, and *Gov_all_0* contains all other observations. *SOEtop1_1* includes observations of suppliers whose largest customer is state-owned (government agencies are also included), and *SOEtop1_0* includes all other observations. Finally, *SOEall_1* represents observations of suppliers with at least one state-owned customer among their top five customers, and *SOEall_0* represents all other observations. All regressions include all variables in the baseline regressions and firm and year fixed effects. The sum of the observations in the two sub-samples (i.e. 4,702) is less than the number of observations in the full sample (i.e. 4,842) because some firms did not report the names of their top five customers and thus we could not identify the nature of the ownership of their customers. The *t*-statistics reported in parentheses are based on standard errors adjusted to be heteroscedasticity robust and clustered at the firm level. To conserve space, we do not report the coefficient estimates for the control variables. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

Table 8. The estimation results of threshold regression models

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	RiskT	*RiskT*	*Z-score*	*Z-score*	*Leverage*	*Leverage*	*R&D*	*R&D*	*Overinvest*	*Overinvest*
Customer_1	0.686**		0.177**		0.101***		2.385**		0.620***	
	(2.05)		(2.45)		(2.88)		(2.11)		(3.01)	
Customer_2	0.181		0.020		0.075**		1.082*		-0.681**	
	(1.40)		(0.26)		(2.14)		(1.91)		(-2.36)	
Customer_3	-0.212***		-0.114**		-0.125***		-0.849		-1.990**	
	(-3.26)		(-2.14)		(-2.63)		(-1.17)		(-2.20)	
HHI_1		1.125*		8.522**		0.752**		8.205		1.164*
		(1.76)		(2.32)		(2.46)		(1.27)		(1.88)
HHI_2		0.306**		-2.844		0.157		-8.400		-1.244**
		(2.55)		(-1.28)		(1.33)		(-1.24)		(-2.18)
HHI_3		-0.414***		-8.682**		-0.190*		-2.297**		-4.746***
		(-2.70)		(-2.37)		(-1.73)		(-2.21)		(-2.80)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	1.111*	1.101*	-5.197***	-5.126***	-0.825***	-0.864***	-8.456	3.248	0.414	0.348
	(1.80)	(1.80)	(-7.00)	(-6.84)	(-3.20)	(-3.33)	(-1.29)	(0.43)	(0.41)	(0.35)
Observations	1728	1728	2200	2200	2345	2345	1876	1876	1890	1890
R-squared	0.061	0.060	0.295	0.295	0.192	0.191	0.222	0.220	0.068	0.070

Notes: This table reports the results based on the threshold model, using different proxies for customer concentration and corporate risk-taking. *Customer* and *CustomerHHI* are proxies for customer concentration. *RiskT*, *Z-score* and *Leverage* are proxies for corporate risk-taking. *Customer_1* in column (1) represents the interval in which *Customer*≤0.091, *Customer_2* represents the interval where 0.091<*Customer*≤0.273, and *Customer_3* represents the interval in which *Customer*>0.273. *HHI_1* in column (2) represents the interval in which *HHI*≤0.030, *HHI_2* that in which 0.030<*HHI*≤0.248, and *HHI_3* that in which *HHI*>0.248. *Customer_1* in column (3) represents the interval in which *Customer*≤0.103, *Customer_2* that in which 0.103<*Customer*≤0.250, and *Customer_3* that in which *Customer*>0.250. *HHI_1* in column (4) represents the interval in which *HHI*≤0.063, *HHI_2* that in which 0.063<*HHI*≤0.161, and *HHI_3* that in which *HHI*>0.161. *Customer_1* in column (5) represents the interval in which *Customer*≤0.168, *Customer_2* that in which 0.168<*Customer*≤0.265, and *Customer_3* that in which *Customer*>0.265. *HHI_1* in column (6) represents the interval in which *HHI*≤0.043, *HHI_2* that in which 0.043<*HHI*≤0.120, and *HHI_3* that in which *HHI*>0.120. Customer_1 in column (7) represents the interval in which Customer≤0.057, Customer_2 that in which 0.057<Customer≤0.377, and Customer_3 that in which Customer>0.377. HHI_1 in column (8) represents the interval in which HHI≤0.085, HHI_2 that in which 0.085<HHI≤0.100, and HHI_3 that in which HHI>0.100. Customer_1 in column (9) represents the interval in which Customer≤0.073, Customer_2 that in which 0.073<Customer≤0.233, and Customer_3 that in which Customer>0.233. HHI_1 in column (10) represents the interval in which HHI≤0.033, HHI_2 that in which 0.033<HHI≤0.124, and HHI_3 that in which HHI>0.124. All regressions include all variables from the baseline regressions and firm and year fixed effects. The number of observations in this table is not 4,842 because we transformed the unbalanced panel into a balanced panel needed for the panel threshold regression. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.