Managing liquidity along the supply chain:

Supplier-base concentration and corporate cash policy

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Abstract

We find that customer firms with more concentrated supplier bases tend to hold higher levels of cash reserves. The positive relation between supplier-base concentration and cash holdings is more pronounced for firms with non-state ownership, higher market competition, worse inventory efficiency, more relationship-specific investment, central positions in the production networks, and headquarters located in regions with lower levels of financial development. Furthermore, we show that debt issuance enhances firms' cash holdings when they have concentrated suppliers, and supplier-base concentration increases firms' cash spending on R&D investment. Our study highlights the importance of supplier structure in shaping corporate cash policy.

JEL Classifications: L23; G30; G32

Keywords: Supplier-base Concentration; Cash Holdings; Source of Cash; Use of Cash

Data Availability: Data used in this study are available from the sources identified in the paper.

1. Introduction

Managing liquidity to finance valuable projects is a critical challenge in financial management. While cash reserves are the most common means by which firms ensure liquidity,[1] liquidity management becomes increasingly challenging in light of rising uncertainty. Since the 1990s, many firms have changed their traditional practice of purchasing from numerous suppliers and have turned to relying on a small set of major suppliers (McMillan 1990; Bensaou 1999; Choi and Krause 2006; Kim and Henderson 2015). With the increased prevalence of concentrated supplier bases, McKinsey (2010) and PwC (2013) report that how to manage and mitigate supply chain uncertainty is one of the top trends that corporate managers foresee. However, despite the importance of supplier-base concentration, there has been limited research on the relation between supply chain uncertainty and corporate cash policy due to the data availability of firms' supplier information.[2] Utilizing unique data on supplier information in the Chinese market, we aim to fill this gap in the literature by examining how supplier-base concentration affects customer firms' liquidity management, specifically their cash holdings.

There are two conflicting views on the relation between supplier-base concentration and customer firms' cash holdings. On the one hand, customer firms tend to hold more cash when their supplier base is more concentrated. First, supplier-base concentration can enhance major suppliers' bargaining power, allowing them to charge higher prices and obtain more favorable trade terms (e.g., Porter 1974; Buffa 1984; Porter 1985). As a result, customer firms' cash flow uncertainty will increase, leading them to maintain more cash reserves. Second,

[1] Meltzer (1963), Miller and Orr (1966), and Baumol (1952) provide earlier literature that focuses on the transaction motivation to hold cash and find that firms tend to hold cash when they face high liquidity risks, because debt capacity cannot provide the same degree of downside protection as cash holdings.

[2] Itzkowitz (2013) is one of the few to focus on the relation between customer-base concentration and corporate cash holdings.

customer firms are exposed to higher operational risk when their supplier structure is more concentrated, as suppliers with stronger bargaining power may deliver goods or services with lower quality or not deliver them on time (e.g., Porter 1974; 1985). This reduces customer firms' inventory efficiency and may lead them to hold more cash to mitigate operational risk. Last, increased supplier-base concentration can amplify customer firms' supply chain disruption risk, such as natural disasters, employee strikes, major machine breakdowns, the COVID-19 pandemic, and geopolitical conflicts (Treleven and Schweikhart 1988; Elmaghraby 2000; Yang et al. 2012). The adverse effects of such disruptions are exacerbated as supplier-base concentration increases (Choi and Krause 2006; Bode and Wagner 2015). In light of the increased risk of supply chain disruption, customer firms may have a strong incentive to hold more cash reserves.

On the other hand, a more concentrated supplier base can facilitate cooperative relationships between customer firms and their suppliers through cost savings due to economies of scale and a reduction of administrative and transaction costs (e.g., Treleven and Schweikhart 1988; Kumar 1996; Bensaou 1999; Burke et al. 2007), which can result in a reduction in cash holdings. First, under a cooperative relationship, higher supplier-base concentration can encourage suppliers to gain a better understanding of their customer firm's unique technologies and products, enabling them to provide higher quality goods and services at a fair price (Dyer and Singh 1998; Moeen et al. 2013). Second, when customer firms establish a cooperative relationship with suppliers, they can better communicate with them and gain information about potential future disruption risks. This can help them make contingency plans to reduce the negative impacts of supply chain disruption risk and, therefore, reduce their cash holdings. Despite these two opposite views, whether supplier-base concentration leads to an increase or decrease in customer firms' cash holdings remains an open empirical question.

To examine the effect of supplier-base concentration on the cash holdings of customer firms, we conduct our study using a comprehensive sample of publicly listed firms in China. China's unique regulatory and market environment provides an ideal setting to gather empirical evidence for our research question. Since 2007, the China Securities Regulatory Commission (hereafter "CSRC") has required all listed firms to disclose the combined procurement from their top five suppliers as a proportion of their total annual procurement. In contrast, it is difficult to examine the impact of supplier-base concentration in the U.S. (Patatoukas 2012),[3] because listed firms in the U.S. are generally not required to disclose their supplier information. To test our predictions, we hand-collect data on the top five suppliers' information disclosed in Chinese listed firms' annual reports.

Our study provides strong evidence that customer firms tend to hold more cash reserves when their top five suppliers account for a larger percentage of their total procurement. Our finding is robust to an alternative measure of supplier-base concentration based on the Herfindahl–Hirschman index, as well as alternative measures of cash holdings. To establish causality, we conduct several identification tests, including two-stage least squares (2SLS) regressions with one instrumental variable, matching methods utilizing propensity scores and entropy balancing, and a change model specification. Our results remain consistent in these identification tests, providing strong support for a causal link between supplier-base concentration and corporate cash holdings.

We next analyze whether the positive relation between supplier-base concentration and corporate cash holdings exhibits any cross-sectional variations. First, we find that the effect of supplier-base concentration on cash holdings is stronger for non-state-owned enterprises

[3] Patatoukas (2012) emphasizes the need for research on how supplier-base concentration impacts customer firms. This research can provide valuable insights into the ongoing debate about the advantages and disadvantages of broadening a firm's supplier base.

(non-SOEs). SOEs, given their special status in China, enjoy several competitive advantages over non-SOEs, such as access to scarce resources, operating with a soft budget constraint, and wielding greater bargaining power. Consequently, non-SOEs with concentrated suppliers tend to have a stronger incentive to maintain higher cash reserves. Second, we find that the positive relation is stronger for firms with weaker market positions. Supplier-base concentration can weaken customer firms' bargaining power, leading to an increase in future cash flow uncertainty. Therefore, firms with weaker market positions have a stronger motivation to hold cash to mitigate such risks. Third, we observe that the positive relation is more pronounced for firms with worse inventory efficiency, supporting the view that supplier-base concentration increases operational risk. Fourth, we show that the positive relation is more prominent for firms with more relation-specific investment. A more concentrated supplier base can increase supply chain disruption risks, and more relation-specific investment can intensify these risks. Hence, customer firms with more relation-specific investment tend to hold more cash as a precautionary measure. Fifth, we find that the positive relation is stronger for firms operating in an industry that is more central to the inter-sectoral production network of the Chinese economy, suggesting that when central firms' supplier structure is less diversified, they need to hold more cash reserves to mitigate aggregate fluctuations induced by shocks in the network. Last, we show that the positive effect is stronger for firms located in regions with lower levels of financial development. Firms in regions with lower levels of financial development have more financial constraints. Therefore, customer firms with concentrated suppliers in these regions have a stronger precautionary motive to hold cash. Our cross-sectional analyses help us to further understand the relation

between supplier-base concentration and corporate cash holdings, and highlight the importance of considering these factors in corporate cash policy.

We also examine the implications of supplier-base concentration for various corporate cash policies beyond cash holdings. First, we explore the sources of cash savings and find that debt issuance enhances firms' cash holdings when they have concentrated suppliers. However, we do not find evidence that other sources, such as equity issuance or internal cash flows, have an impact on firms' cash savings when they have concentrated suppliers. Second, we investigate how firms allocate cash savings toward risky investments. Our results show that firms with higher supplier-base concentration tend to allocate more cash towards R&D expenditures. However, we do not find evidence that supplier-base concentration increases firms' cash spending on capital expenditures and acquisition expenses. Last, we find no evidence that supplier-base concentration affects the value of corporate cash holdings.

Our study makes two contributions to the literature. First, we contribute to the finance and accounting literature on the economic impacts of supply chain characteristics on corporate policies. Prior studies in this area have primarily focused on the impact of customer-base concentration on supplier firms' activities and performance due to the lack of disclosure of major supplier information by U.S. public firms (e.g., Patatoukas 2012; Dhaliwal et al. 2016; Irvine et al. 2016; Campello and Gao 2017; Cohen and Li 2020; Crawford et al. 2020). However, Patatoukas (2012) emphasizes the importance of understanding the impact of supplier-base structure on customer firm decisions and outcomes. In this paper, we advance the earlier literature by utilizing hand-collected data on Chinese public firms' supplier information to examine the relation between supplier-base concentration and corporate cash holdings.

Our paper closely aligns with Itzkowitze (2013), who utilizes customer data from U.S. manufacturing firms to investigate how customer-base concentration affects suppliers' cash holdings. Customer-base concentration, as discussed by Itzkowitze (2013) from a demand-side perspective, focuses on how it may affect corporate cash policy by introducing the risk associated with losing a major customer, potentially jeopardizing the supplier's financial stability. In contrast, our study investigates supplier-base concentration, adopting a supply-side perspective. The downside risk associated with higher supplier-base concentration typically manifests as production halts and supply chain disruptions. Recent global events, such as the COVID-19 pandemic and geopolitical conflicts over the past three years, have demonstrated the widespread supply chain disruptions, highlighting the importance of effectively managing supply chain disruption risk.

Second, our study contributes to the literature on the economic determinants of corporate cash holdings. The existing literature has primarily focused on how firm characteristics such as inventory management, capital expenditures, cash flow volatility, institutional investor monitoring, corporate governance, and internal control influence corporate cash holdings (e.g., Harford et al. 2008; Bates et al. 2009; Harford et al. 2014; Gao and Jia 2016; Ward et al. 2018). However, prior literature has largely overlooked the impact of supply chain characteristics on corporate cash policy. One exception is Itzkowitz (2013), which focuses on the effect of customer-base concentration on corporate cash holdings. By examining the impact of supplier-base concentration on Chinese public firms' cash holdings, our study bridges this research gap and provides a more comprehensive understanding of the supply chain characteristics that drive firms' cash policies.

The remainder of this paper is organized as follows. Section 2 summarizes related literature and discusses how supplier-base concentration affects firms' motivation to hold cash. Section 3 presents our sample description, variable measurement, and model specification. Section 4 reports the results of our empirical analyses. Section 5 concludes.

2. Literature and empirical prediction

Within finance and accounting literature, an expanding body of work has underscored the importance of supplier-customer relations in firm operations (e.g., Patatoukas 2012; Dhaliwal et al. 2016; Chen et al. 2023). Nevertheless, previous studies have predominantly focused on firms' customer structure. Notably, the impact of customer-base concentration on firm performance presents divergent viewpoints (Patatoukas 2012; Irvine et al. 2016; Hui et al. 2019). Extant research has also delved into the effect of customer-base concentration on supplier firms' operations and policies, such as financial policy (Itzkowitz 2013; Dhaliwal et al. 2016; Campello and Gao 2017; Cen et al. 2017), information disclosure (Crawford et al. 2020), cost structure (Chang et al. 2021), and CEO compensation (Chen et al. 2022).

By contrast, there remains a dearth of studies exploring the effect of supplier-base concentration on customer firms, attributable to the limited availability of firms' supplier information. Using unique data from the Chinese market, Casalin et al. (2017) find that firms with more concentrated suppliers benefit from enhanced coordination, leading to reduced inventory holdings. Also relying on the Chinese firms, Chen et al. (2023) treat supplier-base concentration as a risk and document a positive relation between supplier-base concentration and cost elasticity. To further bridge this gap in the literature, we examine the effect of

supplier-base concentration on corporate cash policy—a fundamental aspect that holds significance in corporate finance.

The prior literature on operations management has suggested that a more concentrated supplier base can negatively affect a customer firm's bargaining power and operational management. When supplier-base concentration is high, each supplier has a large share of the customer firm's total procurement, which can lead to a loss of its bargaining power with suppliers (Williamson 1975). This situation is especially pronounced when suppler firms own scarce or critical resources essential to the customer firms' operations. For example, CATL (Contemporary Amperex Technology Co., Ltd.) is a Chinese car battery supplier with major customers that include both large foreign and Chinese domestic electric vehicle companies. Many of CATL's major customers surpass it in terms of market capitalization. Nonetheless, CATL maintains strong bargaining power against these major customers. This is due to CATL's prominent position as a leading battery supplier in the electric vehicle market, stemming from its unique advantages in battery technology and production efficiency, which establish it as a dominant force in the battery supply market. When major suppliers have the advantage in their negotiation with customer firms, they can demand more favorable trade terms and increase their selling prices (e.g., Porter 1974; Buffa 1984; Porter 1985), resulting in an increase in cash flow uncertainty for customer firms. Consequently, customer firms with a more concentrated supplier base may hold more cash as a precaution against future uncertainty.

Moreover, a customer firm that relies heavily on a few major suppliers may face higher operational risk (Elmaghraby 2000; Yang et al. 2012). Higher supplier-base concentration makes it challenging for customer firms to adjust their operational management if those suppliers decrease procurement quality or cannot deliver the goods or services in time (e.g., Porter 1974; 1985). Such operational risks can lead to negative effects on the customer firms'

operation, such as production efficiency. As a result, customer firms tend to hold more cash to mitigate such operational risk.

A more concentrated supplier base may also intensify customer firms' supply chain disruption risks (Treleven and Schweikhart 1988; Elmaghraby 2000; Yang et al. 2012). Unforeseeable events such as natural disasters, employee strikes, major machine breakdown, or geopolitical crises can cause suppliers to fail to provide their products or services on time or severely cut off the supply to customer firms. For example, Barrot and Sauvagnat (2016) find that suppliers affected by idiosyncratic shocks such as major natural disasters impose substantial output losses on their customers, especially when the customer firms use their products as critical inputs. As the supplier-base concentration increases, it becomes increasingly challenging for customer firms to quickly identify suitable alternative suppliers (either from among existing or potential suppliers) to compensate for the larger supply gap during such disruptions. This exacerbates the negative impact of these disruptions, prompting customer firms to increase their cash holdings as a precautionary measure.

However, higher supplier-base concentration can also lead customer firms to reduce their cash holdings. This is attributed to the advantages associated with concentrated supplier bases, including cost savings due to economies of scale and reduced administrative and transaction costs, making it more likely for cooperative relationships to develop between customer firms and their suppliers (e.g., Treleven and Schweikhart 1988; Kumar 1996; Bensaou 1999; Burke et al. 2007). For example, studies by Treleven and Schweikhart (1988), Handfield and Nichols (1999), and Kumar (1996) reveal that customer firms with concentrated supplier bases tend to have a greater motivation to nurture relationships with their suppliers and are more inclined to share cost-related information. Moreover, in cases where the number of major suppliers is reduced due to greater supplier-base concentration, customers can establish more efficient buy-supplier interfaces, leading to cost-effective inventory and order control. This, in turn, makes it easier to build trust with these major suppliers.

A cooperative relationship encourages suppliers to gain a deeper understanding of their customers' unique technologies and products, as well as share cost information. This enables suppliers to deliver higher quality goods and services, improve delivery efficiency (e.g., through better scheduling), and offer fair prices (Dyer and Singh 1998; Moeen et al. 2013; Ward et al. 2018). Therefore, this collaboration can reduce production costs and potentially lead to lower procurement prices for customer firms. In addition, improved communication with suppliers can provide customer firms with early warnings of potential supply disruptions (e.g., strikes), allowing them to quickly explore alternative channels to mitigate future supply shortages. As a result, when supplier-base concentration increases, a cooperative supplier relationship can have a positive effect on customer firms' operational management, ultimately leading to reduced cash holdings.

Although there has been extensive theoretical discussion on how supplier-base concentration affects customer firms' operational management, there is little large sample empirical evidence on this issue, mainly due to data unavailability in the U.S. Therefore, whether supplier-base concentration increases or decreases customer firms' cash holding remains an open empirical question. In our study, we use unique data on supplier information disclosed by Chinese listed firms to examine the relation between supplier-base concentration and customer firms' cash holdings. Our study can provide empirical evidence on the role of supplier-base concentration in operational management, thus addressing the gap in the literature.

3. Sample, variables, and model specification

3.1. Data sources and sample

To begin our study, we identify all firms listed in the Chinese Stock Market between 2007 and 2020. The sample period begins in 2007 because that is when the CSRC began requiring

all listed firms to disclose the combined procurement from their top five suppliers as a percentage of their total annual procurement. We manually collect the procurement data from the top five suppliers of each firm–year in our sample, along with the suppliers' headquarter locations (city) when this information is available. About 50% of the listed Chinese firms disclose the purchases from their top five suppliers separately, and around 30% of the firms disclose their top five suppliers' names.[4]

We require that our sample firms have available accounting data from the China Stock Market and Accounting Research (CSMAR) database. We exclude firms operating in the financial industry because they operate under heavy government regulation and have a unique supplier base. Additionally, we remove firm–year observations that do not have the information about top five suppliers or lack available data on the variables in our baseline regression.

Our main empirical analyses are based on a sample of 28,928 firm–year observations, representing 3,327 unique firms from 2007 to 2020. We tabulate the distribution of our sample by year in Panel A of Appendix A. We observe an increase in the annual number of observations from 841 in 2007 to 3,581 in 2020, which suggests a gradual rise in the number of listed Chinese firms over our sample period. We report the distribution of our sample by the CSRC industry classification in Panel B of Appendix A. The CSRC assign three-digit codes to the manufacturing sector and one-digit codes to other sectors.[5] The top three industries in

[4] Upon examining the names of the disclosed suppliers in the CSMAR database, we find that the majority of them are not listed firms.

[5] The manufacturing sector has a much greater number of firms than the other sectors in the Chinese market. We follow previous literature on the Chinese market and use the CSRC's three-digit codes to refine our industry

terms of observations are computer, communications, and other electronic equipment manufacturing (2,684, C39); information transmission, software, and information technology service industry (2,265, I); and chemical raw materials and chemical products manufacturing (1,963, C26). Meanwhile, the three industries with the lowest number of observations are residential services, repairs, and other services (3, O); comprehensive utilization of waste resources (53, C42); and accommodation and catering (57, H).

3.2. Variables

3.2.1. Dependent variables: Cash holdings

To measure corporate cash holdings, we follow previous studies (e.g., Opler et al. 1999; Itzkowitz 2013) and define our first proxy of cash holdings as the ratio of cash and marketable securities to total assets minus cash and marketable securities (*Cash1*). To ensure the robustness of our findings, we also employ two alternative measures of cash holdings which are used in Faulkender and Wang (2006) and Ward et al. (2018): the ratio of cash and marketable securities to total assets (*Cash2*), and the ratio of cash to total assets (*Cash3*). Using multiple measures to capture the variation in cash holdings ensures that our empirical analyses do not depend solely on variable specification. The three measures complement each other, providing a more comprehensive understanding of corporate cash holdings.

3.2.2. Independent variable of interest: Supplier-base concentration

The primary variable of interest in our study is supplier-base concentration, which measures the degree to which a firm relies on a limited number of major suppliers for its total procurement. Following prior literature on customer-base concentration (e.g., Banerjee et al.

classification in the manufacturing sector. All industry classification mentioned in our empirical analyses follows the definition reported in Panel B of Appendix A.

2008; Dhaliwal et al. 2016), we adopt the proportion of a firm's total purchase from its top five suppliers (*Supplier_purchase*) as our first proxy for supplier-base concentration:

$$Supplier\_purchase_i = \sum_{j=0}^{5} \frac{Purchase_{i,j}}{Purchase_i} \qquad (1)$$

where i represents the firm, j represents the supplier, $Purchase_{i,j}$ is the amount that firm i purchases from its top five supplier j, and $Purchase_i$ is the total purchase amount made by firm i from all suppliers. A higher value of *Supplier_purchase* indicates that a larger proportion of a firm's purchase is from its top five suppliers, i.e., a more concentrated supplier base.

Our second measure of supplier-base concentration follows Patatoukas (2012) and Irvine et al. (2016), who use a Herfindahl–Hirschman Index of sales to major customers to measure customer-base concentration. Specifically, we define:

$$Supplier\_HHI_i = \sum_{j=0}^{5} \left(\frac{Purchase_{i,j}}{Purchase_i}\right)^2 \qquad (2)$$

The value of $Supplier\_HHI$ ranges between zero and one, where a value of zero indicates a perfectly diversified supplier base and a value of one indicates a perfectly concentrated supplier base.[6]

3.3. Baseline regression specification

To formally test the relation between supplier-base concentration and corporate cash holdings, we estimate the following baseline regression model:

$$Cash_{i,t} = \beta_0 + \beta_1 Supplier\_purchase_{i,t} + \sum \beta_i Controls_{i,t}$$

[6] Untabulated results show that our baseline regression results remain robust if we replace $Supplier\_HHI$ with the percentage of purchase from the largest supplier or a Gini coefficient based on the purchases from a firm's top five suppliers.

$$+Firm\ Fixed\ Effects + Year\ Fixed\ Effects\ + \varepsilon_{it} \quad (3)$$

where $Cash_{i,t}$ represents firm i's cash holdings in year t and $Supplier\_purchase_{i,t}$ is firm i's supplier-base concentration measured as the fraction of the purchase from firm i's top five suppliers.

To account for factors that affect corporate cash holdings, we control for a list of variables identified in the prior literature on the determinants of cash holdings (e.g., Opler et al. 1999; Itzkowitz 2013; Ward et al. 2018). We include an indicator variable for state ownership (*SOE*) because state ownership influences a firm's operation (e.g., Dewenter and Malatesta 2001; Chen et al. 2018) and state-owned and non-state-owned firms in China have different cash policies (e.g., Kusnadi et al. 2015). Firms with agency problems tend to hold more cash for the managers' private benefit at the expenses of shareholders (e.g., Jensen 1986; Harford 1999). We account for agency problems resulting from managerial ownership concentration by including the ratio of top-one insider holdings of common stocks to the total shares (*Top1_share*). We also control for the natural logarithm of the number of board directors (*Board_size*) and the ratio of the number of independent directors to the number of board directors (*Board_independence*), because effective corporate boards can monitor managers and mitigate their private benefit motive for cash holding. Consistent with Opler et al. (1999), we control for firm-specific characteristics, such as firm age (*Firm_age*), growth rate of sales revenue (*Sales_growth*), leverage (*Leverage*), return on total assets (*ROA*), cash flow to total assets (*Cash_flow*), and firm size (*Firm_size*). Given that Itzkowitz (2013) documents a positive relation between customer-base concentration and corporate cash holdings, we also control for customer-base concentration (*Customer_sales*), defined as the percentage of the sales that a

firm assigns to its top five customers. Finally, we include the year and firm fixed effects to control for any time-invariant firm-specific omitted variables that are related to both supplier-base concentration and corporate cash holdings. For detailed definitions of all the variables, please refer to Appendix B.

4. Empirical results

4.1. Descriptive statistics

Table 1 presents the descriptive statistics for the main variables in our study. The mean value of our primary dependent variable, *Cash1*, is 0.284, indicating that the cash reserve and marketable securities of an average sample firm account for 28.4% of its non-cash assets. The median value of *Cash1* is 0.181, indicating a positive skewness in the distribution of cash holdings, with more extreme firms in the top 50% than the bottom 50%. The mean value of supplier-base concentration, *Supplier_purchase*, is 0.353, indicating that an average sample firm purchases 35.3% of the procurement from its top five suppliers. The median and standard deviation of *Supplier_purchase* are 0.306 and 0.205, respectively, indicating large cross-sectional variations in supplier-base concentration among our sample firms. The mean value of customer-base concentration, *Customer_sales*, is 0.314, indicating that an average sample firm generates 31.4% of its sales from its top five customers.[7] Additionally, 36.4% of our sample firms are state-owned; the average top-one insider holds 34.2% of firm shares; and the average number of board directors is 8, with 37.5% being independent directors. On average, firm age

[7] The average firm in our sample has a higher level of supplier-base concentration than customer-base concentration, highlighting the relevance and importance of examining supplier-base concentration.

is 8 years, with an annual sales growth rate of 17.9%, a leverage ratio of 43.7%, a return on assets of 3.3%, and a ratio of operating cash flow to total assets of 4.5%.

< Insert Table 1 here >

4.2. Supplier-base concentration and corporate cash holdings

Table 2 presents the results of our baseline regression model, which examines the empirical relation between supplier-base concentration and corporate cash holdings. In column (1) of Table 2, the dependent variable is *Cash1*. The estimated coefficient on *Supplier_purchase* is positive and statistically significant at the 1% level (coefficient = 0.058, two-tail *p*-value < 0.01), indicating that firms with higher supplier-base concentration tend to hold more cash. To ensure the robustness of our finding, we use another two alternative measures for cash holdings: the ratio of cash and marketable securities to total assets (*Cash2*) and the ratio of cash to total assets (*Cash3*). The results presented in columns (2) and (3) show that both the estimated coefficients on *Supplier_purchase* are positive and significantly significant at the 5% level. These results provide further support for the view that firms with a more concentrated supplier base hold more cash.

In terms of economic significance, a one-standard-deviation increase in *Supplier_purchase* is associated with a 1.2% (0.058*0.205), 0.4% (0.017*0.205), and 0.4% (0.018*0.205) increase in corporate cash holdings measured by *Cash1*, *Cash2*, and *Cash3*, respectively. Given that the average firm in our sample has a cash holding ratio of 28.4% (*Cash1*), 19.0% (*Cash2*), and 17.9% (*Cash3*), a one-standard-deviation increase in *Supplier_purchase* translates to a 4.2%

(1.2%/28.4%), 2.1% (0.4%/19.0%), and 2.2% (0.4%/17.9%) higher *Cash1*, *Cash2*, and *Cash3* relative to the sample mean, respectively.

In columns (1)—(3) of Table 2, we control for the firm and year fixed effects, which account for unobserved firm-level heterogeneity and time-varying factors that may affect corporate cash holdings. Gormley and Matsa (2014) indicate that sources of unobserved heterogeneity are commonly across groups of observations. Accordingly, we re-estimate our baseline regression after adding firm fixed effects and interacted year×industry fixed effects, which control for unobserved heterogeneity across firms and time-varying heterogeneity across industries. We tabulate the regression results in columns (4)—(6) of Table 2. The estimated coefficients on *Supplier_purchase* remain positive and statistically significant.

Table 2 also shows that the signs of the estimated coefficients on the control variables are consistent with the findings in the previous literature. Corporate cash holdings are negatively related to firm age (*Firm_age*) and leverage (*Leverage*) but positively related to return on assets (*ROA*), operating cash flows (*Cash_flow*), and customer-base concentration (*Customer_sales*).

< Insert Table 2 here >

As explained in Section 3.2.2, we also measure a firm's supplier-base concentration using the Herfindahl–Hirschman index (*Supplier_HHI*), which is the sum of the squares of the proportion of a firm's total purchase from each of its top five suppliers.[8] A higher value of *Supplier_HHI* indicates the customer firms have more concentrated supplier bases. About 55.7%

[8] Prior studies adopt the Herfindahl–Hirschman index to measure a firm's customer-base concentration (e.g., Patatoukas 2012; Dhaliwal et al. 2016; Irvine et al. 2016).

of our sample firm–year observations voluntarily disclose their purchases from each of the top five suppliers.

The results presented in column (1) of Table 3 show that when the dependent variable is *Cash1*, the estimated coefficient on *Supplier_HHI* is positive and statistically significant at the 1% level (coefficient = 0.133, two-tail *p*-value < 0.01), reinforcing the fact that firms with higher supplier-base concentration hold more cash reserves. Turning to the two alternative measures of cash holdings, the results reported in columns (2) and (3) show that the estimated coefficients on *Supplier_HHI* are also positive and statistically significant at the 5% level when the dependent variables are *Cash2* and *Cash*3.

To calibrate the economic impact to the coefficients, a one-standard-deviation increase in *Supplier_HHI*, holding all other independent variables constant, is associated with a 2.7% (0.133*0.205), 0.8% (0.042*0.205), and 0.9% (0.045*0.205) increase in corporate cash holdings measured by *Cash1*, *Cash2*, and *Cash3*, respectively. The increases translate to a 9.5% (2.7%/28.4%), 4.2% (0.8%/19.0%), and 5.0% (0.9%/17.9%) higher *Cash1*, *Cash2*, and *Cash3* relative to the sample mean, respectively.

In columns (4)—(6) of Table 3, we re-estimate our baseline regression after adding firm fixed effects and interacted year×industry fixed effects. The estimated coefficients on *Supplier_purchase* remain positive and statistically significant. Taken together, the statistical

and economic significance of the coefficient estimates using *Supplier_HHI* are comparable to those reported in Table 2 using *Supplier_purchase*.[9]

< Insert Table 3 here >

4.3. Addressing endogeneity concerns

Firms with high supplier-base concentration and those with low supplier-base concentration may differ in various aspects beyond such concentration. Although we have included several firm characteristics as control variables in our regression model, unobserved firm characteristics other than supplier-base concentration could still lead to the observed difference in corporate cash holdings. For example, firms with a local-focus firm strategy may prefer to work with a shorter list of local suppliers, while firms with a conservative firm culture may hold a large amount of cash for precautionary reasons. Furthermore, a firm's cash policy could potentially affect its bargaining power in the negotiation with its suppliers. Although we have controlled for a combination of firm, year, and industry fixed effects in our baseline regression to address unobserved heterogeneity, we conduct several identification tests to further alleviate potential endogeneity concerns: an instrumental variable approach, propensity score matching and entropy balancing matching methods, and a change analysis.

[9] Itzkowitze (2013) does not reveal any significant effects of supplier-based variables on the cash holdings of customers, which could be attributed to potential limitations in the data of US listed firms. In our paper, we do not consistently find evidence that customer-base concentration is positively related to cash holdings when both customer-base and supplier-base concentration proxies are included in one regression. While the estimated coefficients on *Customer_sales* are positive and statistically significant in Table 2, the estimated coefficients on *Customer_HHI* are statistically insignificant in Table 3.

4.3.1. An instrumental variable approach

Firstly, we use an instrumental variable approach, which relies on the assumption that our chosen instrumental variables are correlated with supplier-base concentration but uncorrelated with the error terms in our baseline regression.

Our instrumental variable, *Cargo*, allows us to extract a plausibly exogenous component of supplier-base concentration. Specifically, *Cargo* is the freight turnover in the province where a firm is registered during a specific year. Freight turnover is calculated as the sum of the products of the number of goods transported by various transportation (including road, rail, air, and sea) and their corresponding transport distance within a year. We standardize *Cargo* to have a mean zero and standard deviation of one. The freight turnover data are from the National Bureau of Statistics of China for each province and year.

We choose *Cargo* as our instrumental variable based on the rationale that higher freight turnover is an indicator of more convenient transportation in a given province. This, in turn, implies that firms operating in provinces with higher freight turnover have access to a greater number of suppliers with more dispersed locations. As a result, we expect a negative relation between *Cargo* and supply-based concentration. Furthermore, any differences in transportation conveniences across provinces are unlikely to be directly linked with a firm's cash holdings. We also include firm and year fixed effects in our tests to help address the possibility that transportation conveniences affect both focal firms and their suppliers concurrently.

Table 4 presents the results of our 2SLS regressions. Column (1) reports the results of the first-stage regression in which the dependent variable is *Supplier_purchase* and the explanatory variables include *Cargo* and the same set of control variables as in our baseline regression. The estimated coefficient on *Cargo* is negative and statistically significant at the 5% level, which confirms our expectation and ensures the relevance requirement of instrumental variable. The Cragg–Donald Wald F-statistic of 23.34, which is above the threshold for strong instruments suggested by Stock et al. (2002), suggests that *Cargo* is not a weak instrumental variable. Columns (2)–(4) of Panel B report the results of the second-stage regressions whose dependent variables are *Cash1*, *Cash2*, and *Cash3*. The estimated coefficients on the predicted *Supplier_purchase* are all positive and statistically significant.

Comparing the estimated coefficients on *Supplier_purchase* in the OLS regressions tabulated in Table 2 with those obtained from the second-stage regressions tabulated in Table 4, we observe that the 2SLS regression coefficients are larger in terms of their magnitudes. It is likely that omitted control variable leads to a spurious negative relation between supplier-based concentration and corporate cash holdings, which attenuates the positive coefficients of *Supplier_purchase* toward zero. Once we use the instrumental variables to address the spurious negative correlation, the endogeneity of the supplier-based concentration is mitigated and the coefficients of *Supplier_purchase* increase. To the extent that our instruments are valid, the results in Table 4 indicate that higher supplier-base concentration causally increases a firm's cash holdings.

< Insert Table 4 here >

4.3.2. Matching analyses

Our second identification method is to correct for any endogenous selection bias driven by observed variables (Dehejia and Wahba 2002; Feng et al. 2009; Lennox et al. 2012). Specifically, we employ two matching techniques to construct treatment and control groups in which the only observed difference between the two groups firms is supplier-base concentration: propensity score matching (PSM) and entropy balancing (EB) matching.

First, we apply PSM and use a conditional logistic regression model to estimate the probability (i.e., the propensity score) that a firm's supplier structure is concentrated. The dependent variable in the logistic regression is *High_Supplier_purchase*, an indicator variable that takes a value of one if a firm's supplier-base concentration (*Supplier_purchase*) is above the annual sample median in the firm's industry and zero otherwise. We include all the control variables in our baseline regression as the covariates in the logistic regression model.[10] Panel A of Appendix C reports the logistic regression results. We find that firms with higher sales growth, lower leverage, lower return on assets, less operating cash flow, smaller firm size, and higher customer-base concentration are more likely to have a concentrated supplier structure.

Based on the estimated propensity scores, we match each firm with a concentrated supplier base (*High_Supplier_purchase* being one) with a firm with a diverse supplier base (*High_Supplier_purchase* being zero) that has the closest propensity score. Our one-to-one

[10] Shipman et al. (2017) argue that the model in the matching stage should not include variables that are excluded from the baseline regression model (Equation (3) in our case).

nearest-neighbor matching is without replacement and with a caliper width of 0.1%.[11] This process generates a propensity score matched sample consisting of 10,666 firm–year observations with concentrated supplier structure (treatment group) and 10,666 matched firm–year observations with diverse supplier structure (control group). In Panel B of Appendix C, we compare the means of covariates between the treatment and control groups. We observe that the differences in the means of the covariates between the treatment and control group are not statistically different, indicating that our PSM procedure successfully achieves covariate balance. The differences in cash holding variables between the treatment group and control group are all statistically significant. This suggests that firms with concentrated supplier structures tend to hold more cash than firms with diverse supplier structures, and that supplier-base concentration is the only distinguishable firm characteristic when comparing cash holdings between the two groups.

Since our PSM sample does not include observations that are not matched in the matching procedure, we follow Hainmueller (2012) and use an entropy balancing (EB) matching to balance the distribution of covariates between treatment and control groups. Specifically, we divide the sample into a control group including firm–year observations with *Supplier_purchase* below the annual sample median in its industry and a treatment group including firm–year observations with *Supplier_purchase* above the annual sample median. Then we reweight the observations in the control group by imposing three balancing conditions: the mean, variance, and skewness of the covariates must be the same between the

[11] Our results are robust if we use a caliper width of 0.3% or 0.5%.

treatment and control groups.[12] EB matching does not require any specific research design to achieve covariate balance, helping to dispel the concern that empirical results may hinge on the model specification in matching procedures (DeFond et al. 2016). Panel C of Appendix C shows that after applying the weights in EB matching, the first, second, and third moments of the covariates are exactly the same between the treatment and control groups.[13]

Next, we compare our three measures of cash holdings between firms in the treatment and control groups. We report the results of our baseline regression Equation (3) in the PSM sample in columns (1)—(3) of Table 5 and those in the EB sample in columns (4)—(6) of Table 5. Consistent with our earlier findings, the estimated coefficients of *Supplier_purchase* remain positive and statistically significant, suggesting that firms with a more concentrated supplier base tend to hold more cash. The magnitude of *Supplier_purchase*'s coefficients estimated from the matched sample is comparable to the magnitude of the coefficients (columns (1)—(3) of Table 2) obtained from the whole sample.

< Insert Table 5 here >

4.3.3. Change analysis

We further use a change analysis to control for the impact of time-invariant firm characteristics on the relation between supplier-base concentration and corporate cash holdings. The change model examines the intertemporal changes in the dependent and

[12] We find similar results if we only balance the mean or the mean and variance of the covariates between the treatment and control samples.

[13] Only about 3% of the observations in the control group have weights greater than 3. Therefore, the extreme weight issue is benign in our EB matching. We also dispel any lingering concerns by verifying that our result remains robust after trimming observations with large weights (above 1 or 3) before rerunning the EB matching.

independent variables, which helps to isolate the effect of time-invariant variables on the dependent variable (Wooldridge 2010). Specifically, we regress the change in cash holdings on the change in supplier-base concentration and the changes in the control variables included in Equation (3).

Table 6 presents the results of the change analysis. The estimated coefficients on the change in supplier-base concentration (*⊿Supplier_purchase*) are positive and statistically significant at the 5% level, supporting the notion that an increase in supplier-base concentration leads to more corporate cash holdings.

< Insert Table 6 here >

Collectively, our three identification tests address the potential endogeneity concerns from different dimensions. Our empirical evidence suggests a causal relation between supplier-base concentration and corporate cash holdings. Although we cannot fully exclude the possibility of an endogenous relation, the consistency of our empirical results across the three identification tests suggests that the observed effect of supplier-base concentration on cash holdings is unlikely to be driven by endogeneity.

4.4. Cross-sectional analyses

We next examine whether the positive relation between supplier-base concentration and corporate cash holdings exhibits any cross-sectional variations with respect to different types of firms.

First, we study whether the positive relation is more pronounced for non-SOEs. In China, SOEs enjoy numerous competitive advantages, including access to scarce resources, a soft

budget constraint, and greater bargaining power. This may lead non-SOEs with concentrated suppliers to have a stronger incentive to hold cash. Second, we investigate whether the positive relation is stronger for firms operating in more competitive markets. Supplier-base concentration can strengthen suppliers' bargaining power, subsequently increasing the level of future cash flow uncertainty for customer firms, especially those with weaker bargaining positions in the market. Therefore, firms facing fiercer market competition have a stronger incentive to use cash reserves to hedge against this cash flow risk. Third, we study whether the positive relation is more pronounced among firms with lower inventory turnover rates. If supplier-base concentration increases firms' operational risk, firms with less efficient inventory turnover may have a stronger precautionary motive to hold cash. Fourth, we test if the positive relation is stronger among firms with higher levels of relation-specific investment. A more concentrated supplier base can elevate supply chain disruption risks, and greater levels of relation-specific investment may intensify these risks. Therefore, firms with higher levels of relation-specific investment may tend to hold more cash. Fifth, we investigate whether the positive relation is more pronounced among firms that play central roles in the production network of the Chinese economy. Central firms with a concentrated supplier base are more exposed to aggregate fluctuations propagating within the network. We expect that they tend to hold more cash reserves when supplier-base concentration increases. Last, we study whether the positive relation is stronger for firms located in regions with lower levels of financial development. Firms in such regions typically have limited access to capital and face higher financial constraints. Therefore, we expect that firms with concentrated suppliers in these regions are more inclined to hold cash as a precautionary measure.

Overall, our cross-sectional tests provide further support for our causal inferences regarding the positive effect of supplier-base concentration on corporate cash holdings.

4.4.1. State ownership

There are two major types of firms based on their ownership structure in China: SOEs and non-SOEs. Compared with non-SOEs, SOEs have numerous competitive advantages due to their special status. First, SOEs have closer relationships with the government, granting them easier access to scarce resources such as franchise rights, land use, and preferential bank loans. Second, SOEs benefit from a softer budget constraint than non-SOEs. In times of severe financial distress, SOEs are more likely to receive government bailouts (e.g., Lin and Tan 1999; Kornai et al. 2003; Stan et al. 2014). Therefore, non-SOEs are generally considered riskier in the long run than SOEs. On the flip side, non-SOEs possess weaker bargaining power than SOEs (Stan et al. 2014), making them more susceptible to the holdup problem. Therefore, based on the precautionary motivation for cash holding, we conjecture that the effect of supplier-base concentration on cash holdings is more pronounced for non-SOEs.

To measure a firm's state ownership structure, we introduce an indicator variable, *SOE*, equal to one if a firm is an SOE and zero otherwise. We then split our main sample into two sub-samples based on *SOE* status and estimate our baseline regression separately within these two sub-samples. Panel A of Table 7 shows that the estimated coefficients on *Supplier_purchase* are positive and statistically significant for non-SOEs, whereas they are statistically insignificant for SOEs. Furthermore, the results from our bootstrapping tests show that the coefficients of *Supplier_purchase* are significantly larger in the sub-sample of non-SOEs than in

the SOE sub-sample. This finding supports our prediction that the positive effect of supplier-base concentration on cash holdings is more pronounced for non-SOEs.

Although a significant portion of Chinese firms have ties to the state or are state-owned, our finding indicates that the impact of supplier-base concentration on firms' cash holdings is more pronounced among non-SOEs than SOEs. When comparing non-SOEs to SOEs in China, non-SOEs often contend with business environments resembling those in countries with market-oriented economies. Therefore, our finding has the potential to yield broader insights into the existing literature, which primarily focused on developed countries.

4.4.2. Market positions

The presence of powerful suppliers can significantly affect a firm's profitability, as it poses a potential threat of price increases or reduced product quality. Centralized procurement and a small number of suppliers offer these suppliers stronger bargaining power, resulting in greater uncertainty over customer firms' future cash flow uncertainty (Porter 2008). Customer firms' market positions also play a crucial role in determining their bargaining power and relationship with suppliers, particularly in product markets with high market competition where the customer firms have few viable alternatives for negotiation with suppliers (e.g., Holmstrom and Roberts 1998). Supplier-base concentration amplifies the need for customer firms with weaker market positions to hold more cash as a precautionary measure against potential cash flow risks. Based on the precautionary motivation for cash holding, we expect a stronger positive relation between supplier-base concentration and cash holdings among customer firms that have weaker market positions.

To measure a customer firm's market position, we utilize the Herfindahl–Hirschman index (HHI) as a proxy, which measures an industry's market concentration. Specifically, we calculate an industry's market concentration, *Indus_HHI*, as the sum of the squared market shares of all firms within that industry. Firms operating in industries with low *Indus_HHI* face greater market competition and therefore have weaker market positions. We then divide our main sample into two sub-samples based on *Indus_HHI*. Firms with *Indus_HHI* above (below) the annual sample median are assigned in the *High* (*Low*) *Indus_HHI* sub-sample. We estimate our baseline regression in the two sub-samples separately.

Panel B of Table 7 shows that the estimated coefficients on *Supplier_purchase* are all positive but only statistically significant for firms in the low *Indus_HHI* sub-samples. Our coefficient comparison tests show that the estimated coefficients on *Supplier_purchase* for firms with low *Indus_HHI* are significantly larger than those for firms with high *Indus_HHI*. This finding is consistent with our expectation that product market competition strengthens supplier firms' bargaining power, and the positive relation between supplier-base concentration and cash holdings is more prominent for firms with weaker market positions.

4.4.3. Inventory efficiency

When a firm's supply chain is dominated by a few powerful suppliers, there is a risk of reduced procurement quality and delayed delivery (e.g., Porter 1974; 1985), which can negatively impact the customer firm's operational activities. To mitigate this risk, customer firms tend to hold more cash. Furthermore, firms with lower inventory efficiency have higher inventory holdings and longer inventory holding periods (e.g., Cachon and Terwiesch 2008; Kelly and Gosman 2000), which can lead to a mismatch between inventory supply and

demand and result in poorer operating performance. Given that firm sales are constrained by available inventory (Anderson et al. 2006; Lai et al. 2011), firms with inventory shortages may experience lost sales. Alternatively, firms holding excess inventory have higher holding costs, which tie up internal capital and increase the risk of obsolescence (Sheppard and Brown 1993; DeHoratius and Raman 2008).[14] Therefore, firms with inefficient inventory management face higher operation risk, and have a higher incentive to hold cash when their supplier-base is concentrated. We predict that the effect of supplier-base concentration on corporate cash holding is more pronounced for firms with lower inventory efficiency.

Following prior literature (e.g., Huson and Nanda 1995; Feng et al. 2015), we use inventory turnover (*Inv_Turnover*) to measure inventory efficiency. *Inv_Turnover* is calculated as the cost of sales in year *t* divided by average inventory between years *t-1* and *t*. We divide our main sample into two sub-samples based on *Inv_Turnover* and estimate the baseline regression separately for each sub-sample. Firms with *Inv_Turnover* above (below) the annual industry median are in the *High* (*Low*) *Inv_Turnover* sub-sample.

Panel C of Table 7 shows that the estimated coefficients on *Supplier_purchase* are positive and statistically significant for firms with low inventory efficiency, but they are statistically insignificant for firms with high inventory efficiency. Additionally, our coefficient comparison tests show that the coefficients of *Supplier_purchase* are significantly larger in the sub-sample of firms with low inventory efficiency than those with high inventory efficiency.

[14] Previous studies show that if obsolete inventory is identified and written off as a current-period expense, it may reduce operating income (e.g., Sheppard and Brown 1993; Gaur et al. 2005; DeHoratius and Raman 2008).

This finding supports our prediction that the positive effect of supplier-base concentration on corporate cash holdings is more pronounced for firms with lower inventory efficiency.

4.4.4. Relationship-specific assets

Previous studies suggest that when a firm's suppliers become more concentrated, the risk of its supply chain disruptions also increase (Treleven and Schweikhart 1988; Elmaghraby 2000; Yang et al. 2012). This is because if a supplier experiences unexpected production issues, they may not be able to deliver products or services on time. Customer firms with a concentrated supplier structure face higher costs in finding alternative suppliers quickly, which may prompt them to hold more cash as a precaution. The impact of supply chain disruption risks is even higher for firms that invest more in relationship-specific assets (Titman 1984; Titman and Wessels 1988). Therefore, we predict that firms with more relationship-specific assets are more affected by supplier-base concentration, leading to higher levels of corporate cash holdings.

We follow the previous literature (e.g., Allen and Phillips 2000; Kale and Shahrur 2007; Raman and Shahrur 2008; Itzkowitz 2013) and use research and development expenses scaled by sales (*R&D*) to proxy for a firm's relationship-specific assets.[15] We divide our main sample into two sub-samples based on *R&D* and estimate the baseline regression separately for each sub-sample. Firms with *R&D* above (below) the annual industry median are in the *High* (*Low*) *R&D* sub-sample.

[15] Some firms in our sample do not disclose their R&D information, so the number of effective observations in this analysis decreases from 28,928 to 22,652.

Panel D of Table 7 shows that the estimated coefficients on *Supplier_purchase* are positive and statistically significant for the sub-sample of firms with more relationship-specific assets. The estimated coefficients on *Supplier_purchase* are statistically insignificant for firms with less relationship-specific assets. Furthermore, our coefficient comparison tests indicate that the difference in the coefficients on *Supplier_purchase* between the two sub-samples is statistically significant. These results support the idea that the impact of supplier-base concentration on customer firms' cash holdings is stronger when they invest more in relationship-specific assets.

4.4.5. Centrality

Firms operating in a highly interconnected production network are susceptible to shocks that can propagate throughout the network (Acemoglu et al. 2012). A recent study by Gao (2021) examines how central firms, which operate in sectors whose production depends heavily on other sectors and are thus more likely to be exposed to shocks in the network, manage liquidity in production networks and finds that they hold more cash reserves to protect themselves and connected firms against shocks in the network. We predict that central firms may need to hold more cash reserves to mitigate the impact of production network shocks, especially when their supplier structure is less diversified.

Following Ahern and Harford (2014) and Gao (2021), we measure closeness centrality of an industry (*Centrality*) in which a firm operates in China's input–output table.[16] A higher

[16]Following Ahern and Harford (2014), we first estimate trade intensity among industries using the input–output table reported by the National Bureau of Statistics of China:

$$A_{ij} = max\left(\frac{s_{ij}}{\sum_k s_{ik}}, \frac{s_{ji}}{\sum_k s_{jk}}\right)$$

where A_{ij} is the trade intensity between industry *i* and industry *j*, s_{ij} is the sales from industry *i* to industry *j*, $\sum_k s_{ik}$ is the total sales of industry *i*, and *k* is the number of industries in the production network. Following

value of *Centrality* indicates that an industry is more important in the national economic network relative to other industries, making it more vulnerable to undiversifiable shocks that propagate in the production network. We divide our main sample into two sub-samples based on *Centrality* and estimate the baseline regression separately for each sub-sample. Firms with *Centrality* above (below) the annual sample median are in the *High* (*Low*) *Centrality* sub-sample.

Panel E of Table 7 shows that the estimated coefficients on *Supplier_purchase* are positive and statistically significant for the subsample of firms in the *High Centrality* sub-sample, while the estimated coefficients on *Supplier_purchase* are statistically insignificant for firms in the *Low Centrality* sub-sample. In addition, our coefficient comparison tests show that the difference in the coefficients on *Supplier_purchase* between the two sub-samples is statistically significant. These results are consistent with our prediction that when a firm's supplier structure is less diversified, central firms tend to hold more cash reserves.

4.4.6. Regional financial development

The prior literature on financial development highlights the primary function of financial markets in overcoming adverse selection and moral hazard problems. The development of financial markets enables them to provide sufficient capital and reduce firms' external financing costs (e.g., Levine 1997; Diamond 1984; Rajan and Zingales 1998). In regions with high levels of financial development, it is easier for financial intermediaries to acquire information about firms seeking capital and to monitor firms effectively. This, in turn,

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Ahern and Harford (2014) and Gao (2021), we define the distance, d(i,j), between industry *i* and industry *j* as the reciprocal of A_{ij}. Similar to Gao (2021), *Centrality* is defined as:

$$Centrality_i = \frac{k-1}{\sum_{k-1} d(i,j)}$$

alleviates firms' financial constraints and reduces their precautionary need to hold cash. Consequently, we predict that firms operating in regions with lower levels of financial development may have a stronger incentive to maintain cash reserves as a safeguard against the risks associated with a more concentrated supplier base.

In line with previous literature (e.g., King and Levine 1993; Demirgüç-Kunt and Maksimovic 1998), we employ the ratio of total loans provided by financial institutions to the province's GDP, where a firm is registered, as a measure of the region's financial development (*Fin_Develop*). We divide our main sample into two sub-samples based on *Fin_Develop* and conduct separate baseline regression analyses for each sub-sample. Firms operating in regions with *Fin_Develop* above (below) its annual median are classified in the *High* (*Low*) *Fin_Develop* sub-sample.

Panel F of Table 7 shows that the estimated coefficients on *Supplier_purchase* are positive and statistically significant for the subsample of firms in the *Low Fin_Develop* sub-sample. In contrast, the estimated coefficients on *Supplier_purchase* are statistically insignificant for firms in the *High Fin_Develop* sub-sample. In addition, our coefficient comparison tests indicate that the difference in the coefficients on *Supplier_purchase* between the two sub-samples is statistically significant. This finding lends support to our prediction that the positive effect of supplier-base concentration on corporate cash holdings is more pronounced for firms operating in regions with lower levels of financial development.

<Insert Table 7 here>

4.5. Additional analyses

4.5.1. Source of cash

Previous studies in the cash savings literature assume that firms hoard internal cash flow as precautionary savings. Kim and Weisbach (2008) and Hertzel and Li (2010) find that firms' cash holdings increase when they issue more equities. In this section, we investigate how supplier-base concentration affects the sources of cash savings. We follow McLean (2011) and classify four sources of cash savings: equity issuance (*Issue*), debt borrowings (*Debt*), internal cash flows (*Cash_flow*), and all other sources including sales of assets and investments (*Others*). Then, we estimate the following regression equation:

$$\begin{aligned}\triangle Cash_{i,t} = {} & \beta_0+\beta_1 Supplier\_purchase_{i,t}+\beta_2 Issue_{i,t} + \beta_3 Supplier\_purchase_{i,t} * \\ & Issue_{i,t}+\beta_4 Debt_{i,t} + \beta_5 Supplier\_purchase_{i,t} * Debt_{i,t}+\beta_6 Cash_{flow}{}_{i,t} + \\ & \beta_7 Supplier\_purchase_{i,t} * Cash\_flow_{i,t}+\beta_8 Other_{i,t} + \\ & \beta_9 Supplier\_purchase_{i,t} * Other_{i,t} + \sum \beta_i Controls_{i,t} + Firm\ Fixed\ Effects + \\ & Year\ Fixed\ Effects\ + \varepsilon_{it} \qquad (4)\end{aligned}$$

where $\triangle Cash_{i,t}$ is the change in firm *i*'s cash holdings over year *t*, $Issue_{i,t}$ is firm *i*'s cash proceeds from share issuance in year *t*, $Debt_{i,t}$ is firm *i*'s cash proceeds from debt sales in year *t*, $Cash\_flow_{i,t}$ is firm *i*'s cash flow from operations in year *t*, and $Other_{i,t}$ is firm *i*'s all other cash sources, which include the sales of assets and investments. All these five variables are scaled by total assets measured at the end of year *t*. The control variables in Equation (4) are the same as those included in our baseline regression Equation (3), except for *Cash_flow*. The coefficients of the interaction terms β_3, β_5, β_7, and β_9, indicate the impact of supplier-base concentration on the sources of cash savings.

Table 8 reports the estimated coefficients in Equation (4). We find that the estimated coefficients on *Debt ×Supplier_purchase* are positive and statistically significant, suggesting that debt issuance enhances firms' cash holding when they have a concentrated supplier structure.[17] Our finding is consistent with Xu et al. (2019) and Jiang et al. (2021) who find that debt issuance is a popular way for Chinese firms to mitigate capital deficits.[18]

<Insert Table 8 here>

4.5.2. Use of cash

In this section, we examine whether firms change their use of their cash reserves for investment purposes in response to an increase in their supplier-base concentration. One possibility is that firms may spend more cash savings on investment in an attempt to reduce their reliance on a small group of suppliers and mitigate supply chain risk. Alternatively, if a few powerful suppliers exert significant influence over a customer firm's managers as agents, then the firm may limit risky investments when supplier-base concentration increases. We build on previous studies by Harford et al. (2008) and Alimov (2014) and focus on the changes in use of cash for capital expenditure, R&D, and acquisitions. Specifically, we estimate the following regression:

$$\triangle Investment_{i,t+1} = \beta_0 + \beta_1 Supplier\_purchase_{i,t} + \beta_2 Cash_{i,t} + \beta_3 Supplier\_purchase_{i,t} * Cash_{i,t} + \sum \beta_i Controls_{i,t} + Firm\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (5)$$

[17] In untabulated tests, we find no evidence that supplier-base concentration is related to either the likelihood of debt issuance or the level of debt issuance. Therefore, it is unlikely that supplier-base concentration directly affects a firm's debt issuance decisions.

[18] Itzkowitze (2013) finds that the source of cash related to customer-base concentration is primarily from equity issuance, while we find that the source of cash related to supplier-base concentration is from debt issuance.

where $\triangle Investment_{i,t+1}$ is one of the three changes in firm *i*'s capital expenditures (*CAPEX*), R&D (*R&D*), and acquisition expenses (A*cquisition*) in year *t+1*. The control variables in Equation (5) are the same as those in our baseline regression.

Table 9 reports the results of our regression analysis. The estimated coefficients on *Supplier_purchase×Cash* are positive and statistically significant in columns (4)—(6) when the dependent variable is $\Delta R\&D$. However, the estimated coefficients on *Supplier_purchase×Cash* are statistically insignificant in columns (1)—(3) and (7)—(9) when the dependent variables are $\Delta CAPEX$ *and* $\Delta Acquisition$. These results suggest that firms with a higher level of supplier-base concentration tend to allocate more cash reserves to R&D expenditures. Overall, our findings highlight the importance of considering supplier-base concentration as a factor that may influence a firm's investment decisions.

<Insert Table 9 here>

4.5.3. Value of cash

Finally, we examine whether supplier-base concentration affects the value of corporate cash holdings. Following the literature on the value of cash, we adopt Faulkender and Wang (2006)'s empirical model to estimate the marginal value of corporate cash holdings. Specifically, the model quantifies a contemporaneous relation between the change in a firm's cash holdings and the corresponding change in its market value of equity. To evaluate the impact of supplier-base concentration on the value of cash, we augment Faulkender and Wang (2006)'s model with supplier-base concentration and its interaction with the change in cash holdings:

$$r_{i,t} - R^{B}_{i,t} = \beta_0 + \beta_1 Supplier_{purchase}{}_{i,t} \times \Delta Cash_{i,t} + \beta_2 \Delta Cash_{i,t} + \beta_3 Supplier_{purchase}{}_{i,t} + \sum \beta_i Controls_{i,t} + Year\ Fixed\ Effects + Firm\ Fixed\ Effects + \varepsilon_{it} \quad (6)$$

where Δ indicates a change in the corresponding variable over a fiscal year, $r_{i,t} - R^{B}_{i,t}$ is the excess stock return of firm *i* in year *t* in excess of the return of one of Fama and French (1993)'s 25 value-weighted portfolios that consists of firms with similar size and book-to-market ratios, and $Controls_{i,t}$ is a vector of control variables including the change in earnings before interest and extraordinary items, the change in net assets, the change in R&D expenses, the change in interest expenses, the change in common dividends, net financing proceeds, cash and market securities in the previous year, market leverage, the interaction between cash and market securities in the previous year and the change in cash holdings, and the interaction between market leverage and the change in cash holdings. Since all the variables except *Supplier_purchase* are normalized by a firm's market value of equity at the end of the fiscal year *t-1*, β_2 represents the dollar change in the market value of equity associated with a dollar increase in cash holdings (the value of cash) and β_1 indicates the effect of supplier-base concentration on the value of cash.[19]

Untabulated results show that the estimated coefficient β_1 is statistically insignificant. We do not find evidence that investors in the Chinese stock market adjust their valuation of a firm's cash holdings according to its supplier-base concentration.

[19] Please refer to Faulkender and Wang (2006) for a detailed explanation of the model.

5. Conclusions

Using unique data on supplier information disclosed by Chinese listed firms, we investigate how supplier-base concentration affects customer firms' cash policy. Our findings reveal that the firms with a more concentrated supplier base tend to maintain larger cash reserves. We also show that the effect of supplier-base concentration on customer firms' cash holdings is more pronounced for firms with non-state ownership, a weaker market position, worse inventory efficiency, more relationship-specific assets, a central position in the production network, and headquarters located in regions with lower levels of financial development. Furthermore, we find that debt issuance enhances firms' cash holdings when they have concentrated suppliers, and supplier-base concentration increases firms' cash spending on R&D investment.

By shedding light on the role of supplier-base concentration as a determining factor of corporate cash policy, our study contributes to resolving the theoretical debate regarding the relation between supplier-base concentration and corporate cash holdings. Our findings hold important implications for corporate policies aiming to optimize liquidity management based on their firm's supplier structure. The positive relation between supplier-base concentration and cash holdings implies that firms strategically maintain cash reserves as a precautionary measure to manage risks associated with their suppliers. A prudent corporate cash policy can serve as a buffer against the negative consequences of supply chain disruptions. It provides firms with the necessary financial resources needed to respond swiftly and effectively, reduce vulnerability, and invest in supply chain resilience and innovation. Firms with concentrated supplier bases can nurture and sustain close supplier relationships by increasing their cash

reserves, thereby ensuring prompt payments and enhancing financial stability. This strategic approach can yield long-term benefits such as preferential treatment from suppliers, favorable pricing agreements, and reliable supply chains.

Appendix A. Sample distributions

Panel A. Sample distribution by year

Year	Observation	Percentage
2007	841	2.91
2008	891	3.08
2009	937	3.24
2010	1,065	3.68
2011	1,447	5.00
2012	1,969	6.81
2013	2,085	7.21
2014	2,154	7.45
2015	1,881	6.50
2016	2,565	8.87
2017	2,887	9.98
2018	3,265	11.29
2019	3,360	11.62
2020	3,581	12.38
Total	28,928	100.00

Panel B. Sample distribution by industry

Industry	Industry code	Observation	Percentage
Agriculture, forestry, animal husbandry, and fishery	A	408	1.41
Mining	B	764	2.64
Agricultural and sideline food processing	C13	383	1.32
Food manufacturing	C14	357	1.23
Wine, beverage, and refined tea manufacturing	C15	443	1.53
Textile	C17	323	1.12
Apparel	C18	289	1.00
Leather, fur, and feathers related products and footwear	C19	65	0.22
Wood processing, and wood, bamboo, rattan, palm, and grass products	C20	71	0.25
Furniture manufacturing	C21	117	0.4
Paper and paper related products	C22	232	0.8
Printing and recorded media reproduction	C23	105	0.36
Manufacture of culture and education, art and crafts, sports and entertainment products	C24	114	0.39
Petroleum processing, coking and nuclear fuel processing	C25	153	0.53
Chemical raw materials and chemical products manufacturing	C26	1,963	6.79

Pharmaceutical manufacturing	C27	1,930	6.67
Chemical fiber manufacturing	C28	233	0.81
Rubber and plastic products	C29	560	1.94
Non-metallic mineral products	C30	742	2.56
Ferrous metal smelting and rolling processing	C31	345	1.19
Non-ferrous metal smelting and rolling processing	C32	696	2.41
metal products	C33	477	1.65
General equipment manufacturing	C34	991	3.43
Special equipment manufacturing	C35	1,585	5.48
Automotive manufacturing	C36	989	3.42
Railroad, marine, aerospace, and other transportation equipment manufacturing	C37	432	1.49
Electrical machinery and equipment manufacturing	C38	1,915	6.62
Computer, communications, and other electronic equipment manufacturing	C39	2,684	9.28
Instrumentation manufacturing	C40	299	1.03
Other manufacturing	C41	101	0.35
Comprehensive utilization of waste resources	C42	53	0.18
Production and supply of electricity, gas, and water	D	1,006	3.48
Construction	E	760	2.63
Wholesale and retail trade	F	1,386	4.79
Transportation, warehousing, and postal services	G	632	2.18
Accommodation and catering	H	57	0.2
Information transmission, software, and information technology services	I	2,265	7.83
Real estate	K	1,063	3.67
Leasing and business services	L	477	1.65
Scientific research and technical service	M	269	0.93
Management of water conservancy, environment, and announcement facilities	N	445	1.54
Residential services, repairs, and other services	O	3	0.01
Education	P	65	0.22
Health and social work	Q	110	0.38
Culture, sports, and entertainment	R	438	1.51
All others	S	133	0.46
	Total	28,928	100

We use the CSRC industry classification (2012), assigning three-digit codes to the manufacturing sector and one-digit codes to other sectors.

Appendix B. Variable definitions

Variable	Definition
Cash1	The ratio of cash and marketable securities to total assets excluding cash and marketable securities.
Cash2	The ratio of cash and marketable securities to total assets.
Cash3	The ratio of cash to total assets.
Supplier_purchase	The ratio of a firm's purchase from its top five suppliers to the total purchase from its suppliers.
Supplier_HHI	The Herfindahl–Hirschman index based on a firm's purchase from its top five suppliers.
SOE	An indicator variable that equals one for state-owned firms and zero for non-state-owned firms.
Top1_share	The ratio of top-one insider holdings of common stocks to the total outstanding shares.
Board_size	The natural logarithm of the number board directors.
Board_independence	The ratio of the number of independent directors to the total number of board directors.
Firm_age	The natural logarithm of one plus the number of years that a firm has been public.
Sales_growth	The growth rate of sales revenue.
Leverage	The ratio of total liabilities to total assets.
ROA	The ratio of net income to total assets.
Cash_flow	The ratio of net cash flows from operating activities to total assets.
Firm_size	The natural logarithm of total assets (in Chinese Yuan).
Customer_sales	The ratio of a firm's sales to its top five customers to the total sales.
Cus_top5HHI	Customer-base concentration measured with the Herfindahl–Hirschman index of the firm's customer base.
Cargo	The freight turnover in the province where a firm is registered during a specific year. Freight turnover is calculated as the sum of the products of the number of goods transported by various transportation (including road, rail, air, and sea) and their corresponding transport distance within a year.
ΔCashHold	The change in cash holdings (*CashHold*) from the prior year to the current year.
ΔSup_top5per	The change in supplier concentration (*Sup_top5per*) from the prior year to the current year.
Indus_HHI	The Herfindahl–Hirschman index of the industry market share.
Inv_Turnover	Cost of sales in year t divided by inventory averaged over years t-1 and t.
R&D	Research and development scaled by sales.
Centrality	The closeness centrality of an industry in which a firm operates in China's input–output table.

Fin_Develop	The ratio of total loans provided by financial institutions to the province's GDP, where a firm is registered.
Issue	Cash proceeds from share issuance scaled by total assets.
Debt	Cash proceeds from debt issuance scaled by total assets.
Other	All other cash sources scaled by total assets.
CAPEX	The ratio of capital expenditures to by total assets.
Acquisition	The ratio of acquisition expenses to sales.

Appendix C. Matching efficiency of PSM and EB matching

Panel A. Pre-match propensity score regression

Variables	*High_Supplier_purchase*
SOE	-0.051
	(-0.74)
Top1_share	-0.059
	(-0.30)
Board_size	-0.013
	(-0.08)
Board_independence	-0.130
	(-0.26)
Firm_age	0.066
	(1.62)
Sales_growth	0.130***
	(4.38)
Leverage	-0.538***
	(-3.76)
ROA	-0.455*
	(-1.68)
Cash_flow	-0.463*
	(-1.86)
Firm_size	-0.380***
	(-13.28)
Customer_sales	2.036***
	(15.54)
Year fixed effects	Yes
Industry fixed effects	Yes
Observations	28,925
Pseudo R^2	0.076

This panel reports the results of a conditional logistic regression model to estimate propensity scores. *High_Supplier_purchase* is an indicator variable that equals one if a firm's supplier-base concentration (*Supplier_purchase*) is above the annual sample median in its industry, and zero otherwise. All variables are defined in Appendix B. The *z-statistics* reported in parentheses are based on standard errors clustering at the firm level. *, ** and *** denote statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Panel B. Matching efficiency of PSM

Variables	Firms with concentrated supplier bases (Treatment) *N* = 10,666 (1)	Firms with diverse supplier bases (Control) *N* = 10,666 (2)	Difference (3)	T-values for mean difference tests (4)
Cash1	0.291	0.270	0.021***	5.073
Cash2	0.191	0.186	0.005**	2.538
Cash3	0.180	0.176	0.004**	2.149
SOE	0.352	0.351	0.001	0.100
Top1_share	0.342	0.341	0.001	0.571
Board_size	2.130	2.129	0.001	0.430
Board_indepence	0.374	0.373	0.001	0.997
Firm_age	2.183	2.182	0.001	0.130
Sales_growth	0.176	0.177	-0.001	-0.113
Leverage	0.431	0.429	0.002	0.546
ROA	0.033	0.034	-0.001	-0.723
Cash_flow	0.046	0.047	-0.000	-0.399
Firm_size	22.020	22.020	0.000	0.005
Customer_sales	0.301	0.300	0.000	0.151

This panel compares the covariates between the treatment and control groups in our PSM test. All variables are defined in Appendix B. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Panel C. Matching efficiency of EB matching

	Treatment (N=14,306)			Control (N=14,622)		
Variables	Mean (1)	Variance (2)	Skewness (3)	Mean (4)	Variance (5)	Skewness (6)
SOE	0.331	0.222	0.718	0.331	0.222	0.718
Top1_share	0.336	0.021	0.576	0.336	0.021	0.576
Board_size	2.120	0.038	-0.385	2.120	0.038	-0.385
Board_indepence	0.375	0.003	1.234	0.375	0.003	1.234
Firm_age	2.162	0.563	-0.325	2.162	0.563	-0.325
Sales_growth	0.186	0.255	3.191	0.186	0.255	3.191
Leverage	0.414	0.048	0.388	0.414	0.048	0.388
ROA	0.030	0.006	-2.235	0.030	0.006	-2.235
Cash_flow	0.042	0.006	-0.140	0.042	0.006	-0.140
Firm_size	21.790	1.427	0.709	21.790	1.427	0.709
Customer_sales	0.361	0.056	0.810	0.361	0.056	0.810

This panel presents the matching efficiency of EB matching.

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Table 1. Descriptive statistics

Variables	Observations	Mean	25%	Median	75%	S.D.
Cash1	28,928	0.284	0.103	0.181	0.331	0.317
Cash2	28,928	0.190	0.094	0.153	0.248	0.135
Cash3	28,928	0.179	0.089	0.144	0.233	0.128
Supplier_purchase	28,928	0.353	0.198	0.306	0.469	0.205
Supplier_HHI	16,122	0.059	0.010	0.025	0.066	0.088
SOE	28,928	0.364	0.000	0.000	1.000	0.481
Top1_share	28,928	0.342	0.227	0.319	0.442	0.147
Board_size	28,928	2.132	1.946	2.197	2.197	0.198
Board_independence	28,928	0.375	0.333	0.333	0.429	0.053
Firm_age	28,928	2.208	1.642	2.311	2.838	0.724
Sales_growth	28,928	0.179	-0.030	0.107	0.272	0.463
Leverage	28,928	0.437	0.268	0.428	0.591	0.213
ROA	28,928	0.033	0.013	0.035	0.065	0.074
Cash_flow	28,928	0.045	0.006	0.045	0.087	0.072
Firm_size	28,928	22.077	21.156	21.908	22.805	1.290
Customer_sales	28,928	0.314	0.144	0.254	0.436	0.224
Customer_HHI	16,122	0.053	0.005	0.017	0.055	0.096

This table presents the mean, 25th percentile (25%), median, 75th percentile (75%), and standard deviation (S.D.) of the main variables in our empirical tests. All variables are defined in Appendix B.

Table 2. Supplier-base concentration and corporate cash holdings

	Cash1	*Cash2*	*Cash3*	*Cash1*	*Cash2*	*Cash3*
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Supplier_purchase	0.058***	0.017**	0.018**	0.049***	0.013*	0.015**
	(3.24)	(2.30)	(2.49)	(2.77)	(1.82)	(2.13)
SOE	0.013	0.002	0.005	0.008	0.001	0.003
	(0.76)	(0.35)	(0.85)	(0.46)	(0.12)	(0.42)
Top1_share	-0.028	-0.000	-0.013	-0.038	-0.002	-0.016
	(-0.64)	(-0.02)	(-0.74)	(-0.85)	(-0.11)	(-0.93)
Board_size	-0.021	-0.005	-0.003	-0.016	-0.004	-0.001
	(-0.95)	(-0.55)	(-0.31)	(-0.71)	(-0.39)	(-0.11)
Board_independence	-0.100	-0.028	-0.019	-0.105*	-0.032	-0.023
	(-1.58)	(-1.07)	(-0.76)	(-1.67)	(-1.22)	(-0.89)
Firm_age	-0.301***	-0.123***	-0.138***	-0.292***	-0.120***	-0.134***
	(-21.23)	(-23.77)	(-27.26)	(-20.23)	(-22.44)	(-25.38)
Sales_growth	-0.006	-0.000	-0.001	-0.006	-0.001	-0.001
	(-1.51)	(-0.26)	(-0.41)	(-1.48)	(-0.34)	(-0.50)
Leverage	-0.358***	-0.177***	-0.154***	-0.356***	-0.177***	-0.153***
	(-13.57)	(-15.93)	(-14.17)	(-13.46)	(-15.90)	(-13.97)
ROA	0.084***	0.062***	0.055***	0.070**	0.058***	0.051***
	(2.67)	(4.55)	(4.23)	(2.16)	(4.20)	(3.79)
Cash_flow	0.450***	0.208***	0.217***	0.442***	0.205***	0.214***
	(14.35)	(16.71)	(17.85)	(13.90)	(16.15)	(17.26)
Firm_Size	0.004	0.001	0.002	0.010	0.003	0.004
	(0.63)	(0.50)	(0.75)	(1.43)	(1.20)	(1.38)
Customer_sales	0.077***	0.024***	0.026***	0.081***	0.026***	0.027***
	(3.44)	(2.74)	(3.01)	(3.61)	(3.02)	(3.20)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	No	No	No
Year×Industry fixed effects	No	No	No	Yes	Yes	Yes
Observations	28,928	28,928	28,928	28,928	28,928	28,928
Adjusted R^2	0.199	0.222	0.248	0.221	0.239	0.263

This table reports the results of OLS regressions that study the relation between corporate cash holdings and supplier-base concentration for Chinese listed firms between 2007 and 2020. The dependent variables are *Cash1*, the ratio of cash and marketable securities to total assets minus cash and marketable securities; *Cash2*, the ratio of cash and marketable securities to total assets; and *Cash3*, the ratio of cash to total assets. The independent variable of interest is *Supplier_purchase*, the proportion of a firm's purchases from its top five suppliers. All variables are defined in Appendix B. We control for the firm and year fixed effects in columns (1)—(3) and firm and year×industry fixed effects in columns (4)—(6). The *t*-statistics reported in parentheses are based on standard errors clustering at the firm level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 3. Alternative measure of supplier-base concentration and corporate cash holdings

	Cash1	*Cash2*	*Cash3*	*Cash1*	*Cash2*	*Cash3*
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Supplier_HHI	0.133***	0.042**	0.045**	0.133***	0.041**	0.046**
	(2.60)	(2.10)	(2.31)	(2.70)	(2.04)	(2.39)
SOE	-0.002	-0.009	-0.007	-0.002	-0.009	-0.008
	(-0.12)	(-1.23)	(-1.01)	(-0.09)	(-1.17)	(-1.15)
Top1_share	-0.042	-0.011	-0.019	-0.015	0.002	-0.010
	(-0.71)	(-0.44)	(-0.78)	(-0.25)	(0.08)	(-0.40)
Board_size	-0.018	-0.008	-0.007	-0.022	-0.012	-0.010
	(-0.66)	(-0.67)	(-0.61)	(-0.78)	(-0.92)	(-0.90)
Board_independence	-0.109	-0.042	-0.026	-0.132*	-0.053	-0.034
	(-1.39)	(-1.25)	(-0.81)	(-1.67)	(-1.58)	(-1.05)
Firm_age	0.217***	0.093***	0.116***	0.210***	0.090***	0.111***
	(-10.58)	(-11.52)	(-15.11)	(-9.70)	(-10.69)	(-13.78)
Sales_growth	-0.000	0.001	0.000	0.000	0.001	-0.000
	(-0.06)	(0.61)	(0.22)	(0.03)	(0.47)	(-0.04)
Leverage	0.359***	0.175***	-0.149***	-0.361***	-0.176***	-0.150***
	(-9.41)	(-10.89)	(-9.50)	(-9.25)	(-10.75)	(-9.31)
ROA	0.048	0.039**	0.031**	0.018	0.029*	0.022
	(1.32)	(2.44)	(2.05)	(0.49)	(1.74)	(1.38)
Cash_flow	0.429***	0.208***	0.213***	0.405***	0.198***	0.205***
	(10.96)	(12.89)	(13.83)	(10.48)	(12.42)	(13.27)
Firm_size	0.023**	0.010**	0.010***	0.029***	0.013***	0.012***
	(2.26)	(2.51)	(2.60)	(2.84)	(3.00)	(2.99)
Customer_HHI	0.036	0.013	0.014	0.050	0.017	0.018
	(0.65)	(0.59)	(0.70)	(0.90)	(0.80)	(0.90)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	No	No	No
Year×Industry fixed effects	No	No	No	Yes	Yes	Yes
Observations	16,122	16,122	16,122	16,122	16,122	16,122
Adjusted R^2	0.153	0.173	0.201	0.179	0.193	0.219

This table reports the results of the robustness tests of the relation between supplier-base concentration and corporate cash holdings, using an alternative independent variable of interest *Supplier_HHI*. *Supplier_HHI* is the Herfindahl-Hirschman index based on a firm's purchases from its top five suppliers. The dependent variables are *Cash1*, *Cash2*, and *Cash3*. All variables are defined in Appendix B. We control for the firm and year fixed effects in columns (1)—(3) and firm and year×industry fixed effects in columns (4)—(6). The t-statistics reported in parentheses are based on standard errors clustering at the firm level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 4. Mitigating endogeneity: Instrumental variable

	First-stage	Second-stage		
	Supplier_purchase	*Cash1*	*Cash2*	*Cash3*
Variables	(1)	(2)	(3)	(4)
Predicted Supplier_purchase		2.338*	0.781*	1.015*
		(1.89)	(1.73)	(1.95)
Cargo	-0.007**			
	(-2.40)			
SOE	0.015	-0.020	-0.009	-0.009
	(1.41)	(-0.60)	(-0.73)	(-0.64)
Top1_share	-0.018	0.013	0.013	0.005
	(-0.72)	(0.17)	(0.48)	(0.16)
Board_size	-0.013	0.007	0.004	0.009
	(-0.96)	(0.17)	(0.29)	(0.56)
Board_independence	-0.032	-0.029	-0.004	0.012
	(-0.84)	(-0.27)	(-0.10)	(0.25)
Firm_age	-0.021***	-0.252***	-0.106***	-0.116***
	(-3.16)	(-7.34)	(-8.43)	(-8.00)
Sales_growth	0.006***	-0.020*	-0.005	-0.007
	(2.66)	(-1.90)	(-1.38)	(-1.57)
Leverage	0.001	-0.359***	-0.177***	-0.155***
	(0.09)	(-8.83)	(-11.93)	(-8.96)
ROA	0.028	0.021	0.041*	0.028
	(1.50)	(0.34)	(1.78)	(1.05)
Cash_flow	-0.047***	0.558***	0.245***	0.264***
	(-2.87)	(7.15)	(8.59)	(8.03)
Firm_size	-0.035***	0.085*	0.028*	0.037*
	(-7.98)	(1.86)	(1.71)	(1.94)
Customer_sales	0.234***	-0.455	-0.154	-0.207*
	(15.04)	(-1.56)	(-1.45)	(-1.68)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	28,927	28,927	28,927	28,927
Adjusted R^2	0.089	0.078	0.106	0.031
Cragg–Donald Wald F statistic	23.34 (p<0.001)			

This panel reports the results of 2SLS regressions. Column (1) reports the first-stage regression results, in which the dependent variable is Supplier_purchase and the instrumental variable is Cargo, the standardized freight turnover in the province where a firm is registered in a year. Columns (2)—(4) report the second-stage regression results, in which the dependent variables are Cash1, Cash2, and Cash3, and the independent variable of interest is predicted Supplier_purchase. All variables are defined in Appendix B. All specifications include firm and year fixed effects. The t-statistics reported in parentheses are based on standard errors clustering at the firm level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 5. Mitigating endogeneity: PSM and EB matching

	PSM			EB		
	Cash1	*Cash2*	*Cash3*	*Cash1*	*Cash2*	*Cash3*
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Supplier_purchase	0.052***	0.014*	0.016**	0.055***	0.016**	0.016**
	(2.80)	(1.77)	(2.08)	(2.64)	(2.00)	(2.08)
SOE	-0.000	-0.004	0.001	0.018	0.003	0.006
	(-0.00)	(-0.57)	(0.17)	(0.98)	(0.49)	(0.86)
Top1_share	-0.019	-0.002	-0.009	-0.043	-0.006	-0.016
	(-0.40)	(-0.12)	(-0.45)	(-0.87)	(-0.30)	(-0.81)
Board_size	-0.037	-0.011	-0.006	-0.037	-0.010	-0.005
	(-1.51)	(-1.08)	(-0.63)	(-1.34)	(-0.91)	(-0.49)
Board_independence	-0.129*	-0.035	-0.027	-0.153**	-0.037	-0.027
	(-1.82)	(-1.20)	(-0.94)	(-1.99)	(-1.26)	(-0.93)
Firm_age	0.316***	0.129***	0.142***	0.327***	0.133***	0.147***
	(-20.54)	(-22.93)	(-25.98)	(-20.61)	(-23.42)	(-26.55)
Sales_growth	-0.006	-0.000	-0.000	-0.008*	-0.001	-0.001
	(-1.44)	(-0.18)	(-0.24)	(-1.85)	(-0.57)	(-0.68)
Leverage	0.359***	0.177***	0.154***	0.375***	0.185***	0.163***
	(-12.63)	(-14.58)	(-13.10)	(-12.21)	(-14.24)	(-12.70)
ROA	0.044	0.051***	0.044***	0.067*	0.055***	0.047***
	(1.30)	(3.37)	(3.08)	(1.68)	(3.38)	(3.01)
Cash_flow	0.469***	0.216***	0.225***	0.467***	0.210***	0.217***
	(14.04)	(15.72)	(16.70)	(11.94)	(13.69)	(14.47)
Firm_Size	0.018**	0.006**	0.006**	0.004	0.001	0.001
	(2.53)	(2.16)	(2.14)	(0.48)	(0.33)	(0.48)
Customer_sales	0.045**	0.015*	0.018**	0.088***	0.027***	0.029***
	(2.13)	(1.73)	(2.14)	(3.56)	(2.88)	(3.20)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	21,332	21,332	21,332	28,928	28,928	28,928
Adjusted R^2	0.213	0.234	0.260	0.218	0.244	0.271

This table reports the results of our baseline regression estimated in the propension score matching (PSM) sample and entropy balancing (EB) matching sample. Columns (1)—(3) report the regression results of the PSM sample. Columns (4)—(6) report the regression results of the EB sample. Please refer to Appendix C for the matching regression results of PSM and the matching efficiency of PSM and EB matching. All variables are defined in Appendix B. The t-statistics reported in parentheses are based on standard errors clustering at the firm level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 6. Mitigating endogeneity: Change analysis

	△Cash1	*△Cash2*	*△Cash3*
Variables	(1)	(2)	(3)
△Supplier_purchase	0.012**	0.011**	0.025**
	(2.46)	(2.29)	(2.23)
△SOE	-0.000	-0.002	-0.004
	(-0.06)	(-0.45)	(-0.35)
△Top1_share	-0.049**	-0.058***	-0.079*
	(-2.33)	(-2.87)	(-1.76)
△Board_size	-0.006	-0.007	-0.012
	(-0.83)	(-0.93)	(-0.74)
△Board_independence	-0.009	-0.001	-0.043
	(-0.48)	(-0.07)	(-1.05)
△Firm_age	-0.280***	-0.278***	-0.799***
	(-24.44)	(-25.34)	(-24.77)
△Sales_growth	-0.007***	-0.006***	-0.018***
	(-5.80)	(-5.58)	(-7.02)
△Leverage	-0.157***	-0.145***	-0.293***
	(-14.97)	(-14.61)	(-12.80)
△ROA	-0.032***	-0.033***	-0.072***
	(-2.91)	(-3.26)	(-3.12)
△Cash_flow	0.219***	0.212***	0.433***
	(24.95)	(24.98)	(22.05)
△Firm_size	0.060***	0.056***	0.119***
	(14.58)	(14.37)	(13.33)
△Customer_sales	0.016**	0.012*	0.036**
	(2.33)	(1.90)	(2.45)
Firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	24,509	24,509	24,509
Adjusted R^2	0.146	0.138	0.151

This table reports the results of the change analysis. *Δ* indicates a change in a variable from year *t-1* to year *t*. All variables are defined in Appendix B. We control for the firm and year fixed effects in all columns. The *t*-statistics reported in parentheses are based on standard errors clustering at the firm level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 7. Cross-sectional analyses

Panel A. State ownership

Variables	*Cash1*		*Cash2*		*Cash3*	
	SOE=0	*SOE=1*	*SOE=0*	*SOE=1*	*SOE=0*	*SOE=1*
	(1)	(2)	(3)	(4)	(3)	(4)
Supplier_purchase	0.077***	0.017	0.022**	0.005	0.023**	0.006
	(3.17)	(0.72)	(2.26)	(0.44)	(2.46)	(0.55)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,410	10,518	18,410	10,518	18,410	10,518
Adjusted R^2	0.249	0.096	0.274	0.126	0.308	0.120
Difference in coef. on	(1) – (2)		(3) – (4)		(5) – (6)	
Supplier_purchase	p-value < 0.05 **		p-value <0.10 *		p-value < 0.10 *	

Panel B. Market positions

Variables	*Cash1*		*Cash2*		*Cash3*	
	Low Indus_HHI	*High Indus_HHI*	*Low Indus_HHI*	*High Indus_HHI*	*Low Indus_HHI*	*High Indus_HHI*
	(1)	(2)	(3)	(4)	(3)	(4)
Supplier_purchase	0.105***	0.033	0.034***	0.008	0.036***	0.008
	(4.19)	(1.33)	(3.43)	(0.77)	(3.77)	(0.79)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,975	13,953	14,975	13,953	14,975	13,953
Adjusted R^2	0.245	0.152	0.259	0.184	0.293	0.200
Difference in coef. on	(1) – (2)		(3) – (4)		(5) – (6)	
Supplier_purchase	p-value < 0.01 ***		p-value < 0.01 ***		p-value < 0.01 ***	

Panel C. Inventory efficiency

Variables	*Cash1*		*Cash2*		*Cash3*	
	Low Inv_Turnover	*High Inv_Turnover*	*Low Inv_Turnover*	*High Inv_Turnover*	*Low Inv_Turnover*	*High Inv_Turnover*
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier_purchase	0.120***	0.043	0.039***	0.014	0.041***	0.011
	(4.70)	(1.62)	(3.74)	(1.42)	(4.07)	(1.12)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,444	14,342	14,444	14,342	14,444	14,342
Adjusted R^2	0.207	0.173	0.227	0.197	0.258	0.215
Difference in coef. on	(1) – (2)		(3) – (4)		(5) – (6)	

Supplier_purchase	p-value < 0.01 ***	p-value < 0.05 **	p-value < 0.01 ***

Panel D. Relationship-specific assets

Variables	*Cash1*		*Cash2*		*Cash3*	
	Low R&D	*High R&D*	*Low R&D*	*High R&D*	*Low R&D*	*High R&D*
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier_purchase	-0.015	0.122***	-0.005	0.032**	-0.001	0.036***
	(-0.65)	(3.43)	(-0.48)	(2.42)	(-0.12)	(2.85)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,515	11,137	11,515	11,137	11,515	11,137
Adjusted R^2	0.155	0.303	0.178	0.322	0.198	0.363
Difference in coef. on	(1) – (2)		(3) – (4)		(5) – (6)	
Supplier_purchase	p-value < 0.01 ***		p-value < 0.01 ***		p-value < 0.01***	

Panel E. Centrality

Variables	*Cash1*		*Cash2*		*Cash3*	
	Low Centrality	*High Centrality*	*Low Centrality*	*High Centrality*	*Low Centrality*	*High Centrality*
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier_purchase	0.021	0.102***	0.005	0.032***	0.009	0.027***
	(0.91)	(3.55)	(0.54)	(2.89)	(0.88)	(2.63)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,596	14,332	14,596	14,332	14,596	14,332
Adjusted R^2	0.178	0.219	0.202	0.240	0.222	0.268
Difference in coef. on	(1) – (2)		(3) – (4)		(5) – (6)	
Supplier_purchase	p-value < 0.01 ***		p-value < 0.01 ***		p-value < 0.05 **	

Panel F. Regional financial development

Variables	*Cash1*		*Cash2*		*Cash3*	
	Low Fina_Develop	*High Fina_Develop*	*Low Fina_Develop*	*High Fina_Develop*	*Low Fina_Develop*	*High Fina_Develop*
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier_purchase	0.075***	0.036	0.027***	0.005	0.029***	0.007
	(2.97)	(1.46)	(2.67)	(0.52)	(3.00)	(0.69)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,548	16,379	12,548	16,379	12,548	16,379
Adjusted R^2	0.194	0.219	0.216	0.241	0.234	0.272
Difference in coef. on	(1) – (2)		(3) – (4)		(5) – (6)	
Supplier_purchase	p-value < 0.10 *		p-value < 0.05 **		p-value < 0.05 **	

This table reports the results of our cross-sectional analyses. Panel A focuses on firms' state ownership, where a firm's ownership type is indicated by an *SOE* variable. It takes the value of one if a firm is an SOE and zero if it is a non-SOE. Panel B focuses on firms' market positions. *Indus_HHI* is the Herfindahl–Hirschman index of industry market shares, calculated as the sum of the squared market shares of firms in the industry. Firms with *Indus_HHI* above (below) the annual sample median are in the *High* (*Low*) *Indus_HHI* sub-sample. Panel C focuses on firms' inventory efficiency. *Inv_Turnover* is calculated as the cost of sales in year *t* divided by the average inventory between year *t – 1* and *t*. Firms with *Inv_Turnover* above (below) the annual industry median are in the High (Low) *Inv_Turnover* sub-sample. Panel D focuses on firms' relationship-specific assets, with *R&D* measured as research and development expenses scaled by sales. Firms with *R&D* above (below) the annual industry median are in the *High* (*Low*) *R&D* sub-sample. Panel E focuses on firms' centrality, defined as a sector's dependence on the supply of productive input and the purchase of its output by all other sectors, including the dependence through higher order linkages. Following Gao (2021), we calculate *Centrality* based on China's input–output table. Firms with *Centrality* above (below) the annual sample median are in the High (Low) *Centrality* sub-sample. Panel F focuses on the financial development of regions where firms are located. *Fina_Develop* is measured as the ratio of total loans provided by financial institutions to GDP in each province. Firms located in regions with *Fina_Develop* above (below) the annual median are in the High (Low) *Fina_Develop* sub-sample. All variables are defined in Appendix B. All specifications include firm and year fixed effects. The statistical significance of the differences in the estimated coefficients on *Supplier_purchase* between two sub-samples is examined using Fisher's Permutation tests based on 1,000 bootstrap iterations. The t-statistics reported in parentheses are based on standard errors clustering at the firm level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 8. Source of cash

	△Cash1	*△Cash2*	*△Cash3*
Variables	(1)	(2)	(3)
Supplier_purchase	1.161***	0.603***	0.588***
	(22.99)	(28.14)	(29.73)
Issue	-0.029*	-0.009	-0.011*
	(-1.67)	(-1.31)	(-1.73)
Issue×Supplier_purchase	-0.084	-0.070	-0.055
	(-0.66)	(-1.31)	(-1.12)
Debt	0.674***	0.352***	0.331***
	(8.02)	(8.34)	(8.07)
Debt×Supplier_purchase	0.580***	0.259**	0.281***
	(2.61)	(2.35)	(2.61)
Cash_flow	-0.019**	-0.010***	-0.009***
	(-2.02)	(-2.70)	(-2.74)
Cash_flow×Supplier_purchase	0.036*	0.011	0.010
	(1.72)	(1.52)	(1.44)
Other	0.972***	0.512***	0.565***
	(20.03)	(26.41)	(31.35)
Other×Supplier_purchase	0.098	-0.003	-0.015
	(0.83)	(-0.06)	(-0.35)
Controls	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	24,509	24,509	24,509
Adjusted R^2	0.345	0.394	0.452

This table reports the results of regression Equation (4), which examines the relation between supplier-base concentration and sources of cash. The dependent variable is the change in three cash holding variables from year *t-1* to year *t*: *△Cash1*, *△Cash2*, and *△Cash3*. *Issue* is cash proceeds from share issuance. *Debt* is cash proceeds from debt sales. *Cash_flow* is cash flow from operations. *Other* is all other cash sources, which include the sales of assets and investments. All four cash sources' measures are scaled by total assets at the end of year *t*. All variables are defined in Appendix B. All specifications include firm and year fixed effects. The *t*-statistics reported in parentheses are based on standard errors clustering at the firm level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 9. Use of cash

	ΔCAPEX			*ΔR&D*			*ΔAcquisition*		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Supplier_purchase	0.001	-0.001	-0.000	0.004**	0.003	0.003*	0.016	0.018	0.013
	(0.15)	(-0.19)	(-0.05)	(2.42)	(1.51)	(1.74)	(0.55)	(0.53)	(0.38)
Cash1	0.057***			-0.001			0.020		
	(12.11)			(-0.55)			(1.36)		
Cash1×Supplier_purchase	-0.012			0.005*			-0.040		
	(-1.13)			(1.77)			(-1.41)		
Cash2		0.136***			-0.004			0.049	
		(13.09)			(-1.47)			(1.10)	
Cash2×Supplier_purchase		-0.003			0.014**			-0.076	
		(-0.14)			(1.98)			(-0.86)	
Cash3			0.147***			-0.005			0.034
			(13.50)			(-1.57)			(0.89)
Cash3×Supplier_purchase			-0.009			0.012*			-0.048
			(-0.35)			(1.67)			(-0.58)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,509	24,509	24,509	20,921	20,921	20,921	24,509	24,509	24,509
Adjusted R^2	0.071	0.074	0.075	0.038	0.037	0.037	0.005	0.005	0.005

This table reports the results of regression Equation (5) that investigates the relation between supplier-base concentration and use of cash. The dependent variable is *ΔCAPEX* in columns (1)—(3), *ΔR&D* in columns (4)—(6), and *ΔAcquisition* in columns (7)—(9). *Δ* indicates a change in a variable from year *t-1* to year *t*. All variables are defined in Appendix B. All specifications include firm and year fixed effects. The *t*-statistics reported in parentheses are based on standard errors clustering at the firm level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.