

Competition Pressure or Cooperative Governance? Customer Concentration and Investment Inefficiency

Jingshuo Yan

yjs393939@hanyang.ac.kr

Hanyang University

JeongHwan Lee

Hanyang University

Article

Keywords: Customer concentration, Investment inefficiency, Competitive pressure, Cooperative governance

Posted Date: October 22nd, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11118902/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.
[Read Full License](#)

Additional Declarations: No competing interests reported.

Competition Pressure or Cooperative Governance? Customer Concentration and Investment Inefficiency

Abstract

This paper investigates the impact of customer concentration on corporate inefficient investment from the dual perspectives of competitive pressure and cooperative governance. Based on a sample of non-financial A-share listed companies in China from 2010 to 2022, the study finds a significant inverted U-shaped relationship between customer concentration and inefficient investment. At low to moderate levels of customer concentration, increases in concentration exacerbate inefficient investment, whereas at higher levels, the adverse marginal effect gradually weakens and eventually reverses. Mechanism tests indicate that analyst coverage, payment pressure, and financing constraints are important channels through which customer concentration affects investment efficiency. Heterogeneity analysis shows that this relationship is more pronounced in non-state-owned enterprises, manufacturing firms, companies with higher market share, and those with lower institutional ownership. Further analysis reveals that this effect is evident in both over-investment and under-investment types of inefficient investment. The robustness of the main findings is confirmed using alternative variables, instrumental variable estimation, lagged variables, and propensity score matching. Overall, the results demonstrate that customer concentration represents a supply chain relational structure with stage-dependent characteristics, and its impact on investment efficiency depends on the dynamic interplay between competitive pressure and cooperative governance mechanisms.

Keywords: Customer concentration, Investment inefficiency, Competitive pressure, Cooperative governance

1 Introduction

How to enhance corporate investment efficiency has long been a critical issue in achieving sustainable development strategies for enterprises. Sustainable growth can only be genuinely secured when limited capital is effectively allocated to projects capable of generating long-term economic returns. Conversely, both over-investment and under-investment can result in resource misallocation and reduce investment efficiency

(Richardson 2006). Existing research has extensively demonstrated that agency problems, information asymmetry, and financing frictions are major drivers of inefficient corporate investment, while a high-quality information environment and effective market mechanisms contribute to improved investment efficiency (Biddle and Hilary 2006; Biddle et al. 2009; Chen et al. 2011; McNichols and Stubben 2008).

However, corporate investment decisions are not made in isolation from the product market. On the contrary, corporate investment behaviors are continuously shaped by product market relationships, indicating that investment decisions are deeply embedded within supply chain structures. The supply chain not only facilitates the flow of goods between suppliers and customers but also serves as a conduit for information transmission, value exchange, and contractual arrangements. According to resource dependence theory, firms develop varying degrees of dependence on external resource providers as they acquire critical resources, and such dependencies can further influence firms' resource allocation behaviors (Paulraj and Chen 2007; Alkhuzaim et al. 2022; Chiang and Chuang 2024). From the perspective of transaction cost economics, interdependence among supply chain firms may give rise to bargaining frictions, transaction uncertainty, and issues related to asset specificity, thereby affecting firms' investment decisions and the efficiency of resource allocation (Bharadwaj and Matsuno 2006; Cai et al. 2024). Within the entire supply chain system, customer concentration plays a particularly significant role. Existing studies have found that customer concentration can influence a firm's financing costs, profitability, stock price crash risk, and innovation investment (Patatoukas 2012; Dhaliwal et al. 2016; Hui et al. 2019; Lee et al. 2020; Ma et al. 2020).

The potential impact of customer concentration is especially pronounced in the Chinese context. Compared to U.S. firms, customer dependence is more prevalent among Chinese listed companies. Pan et al. (2020) found that among listed suppliers reporting at least one major customer, 43% of Chinese firms have more than one customer accounting for over 10% of sales, whereas the corresponding figure for U.S. firms is approximately 8%. Therefore, examining the effect of customer concentration on the investment efficiency of Chinese listed companies not only helps to elucidate how supply chain relationships affect corporate investment decisions, but also bears significant practical relevance.

However, existing research has primarily approached the economic consequences of customer concentration from two perspectives. On one hand, the competitive pressure perspective suggests that concentrated customers, leveraging their stronger bargaining power, can extract rents by imposing lower prices, extending payment terms, and shifting costs to suppliers (Campello and Gao 2017; Fabbri and Klapper 2016; Ni et al. 2023). In such cases, customer concentration may exacerbate suppliers' cash flow pressures and financing constraints, thereby distorting investment decisions. On the other hand, the cooperative governance perspective posits that building stable relationships with major customers can facilitate information sharing, coordinate resource allocation, and improve firm performance (Kalwani and Narayandas 1995; Patatoukas 2012; Irvine et al. 2016). Stable customer relationships help to enhance demand predictability, reduce transaction uncertainty, and improve supply chain coordination efficiency. Therefore, the question of how customer concentration ultimately affects

firms' resource allocation efficiency remains an important issue warranting further investigation. Specifically, there are three issues in existing research that remain insufficiently addressed. First, does customer concentration affect corporate investment efficiency? Second, given that both competitive pressure and cooperative governance effects may coexist, does the impact of customer concentration change or even reverse as the degree of customer dependence increases? Third, through which channels do the coexistence and transformation of these mechanisms influence corporate investment efficiency?

To address the aforementioned questions, this study uses Chinese A-share listed companies as the research sample to systematically examine whether the impact of customer concentration on corporate inefficient investment exhibits marginal changes as customer concentration increases. The findings reveal that the marginal effect of customer concentration on inefficient investment is not constant; rather, it gradually weakens as customer concentration rises, and eventually shifts from a positive to a negative effect. Specifically, when customer concentration is at a low to moderate level, an increase in customer concentration significantly exacerbates inefficient investment, indicating that the competitive pressure mechanism dominates at this stage. However, as customer concentration continues to rise, its adverse marginal effect diminishes and, at higher levels, transforms into a restraining effect on inefficient investment. This suggests that the cooperative governance effect arising from stable customer relationships begins to offset the earlier negative impact of competitive pressure.

Channel analysis shows that when customer concentration is in the low to moderate range, increases in customer concentration reduce analyst coverage and intensify payment pressure and financing constraints, thereby driving up inefficient investment. In contrast, at higher levels of customer concentration, these adverse channel effects gradually weaken. This indicates that as customer relationships stabilize, mechanisms such as information sharing and supply chain coordination may become more influential, partially counteracting the initial negative effects induced by customer bargaining pressure. This finding is consistent with the logic of "competitive pressure dominance in the early stage and enhanced cooperative governance in the later stage." Further heterogeneity analyses indicate that these marginal effect changes are more pronounced among non-state-owned enterprises, manufacturing firms, companies facing higher market competition, and those with lower institutional ownership. Moreover, additional analyses show that this effect is evident in both over-investment and under-investment. Finally, the core conclusions of this study remain robust after employing alternative variables, instrumental variables, lagged variables, propensity score matching, and placebo tests.

This study makes several major contributions. First, by incorporating customer concentration as an important external determinant of inefficient investment into the research framework, it expands the literature on corporate investment efficiency. Whereas existing research has mainly explained inefficient investment from the perspectives of internal agency problems, information quality, and financing frictions, this study demonstrates that dependence on major customers can also profoundly affect firms' investment decision-making. Second, rather than examining only the linear effect of customer concentration on inefficient investment, this study identifies

the changing marginal effects as customer dependence deepens, thus providing new evidence to explain the coexistence of the competitive pressure and cooperative governance perspectives in the customer concentration literature. Third, by investigating the marginal changes in mechanisms such as analyst coverage, payment pressure, and financing constraints, this study further elucidates the specific pathways through which customer concentration affects investment efficiency, offering a new perspective for understanding how external transactional relationships shape corporate investment behavior.

2 Literature Review and Hypothesis Development

Customer concentration essentially reflects the degree of transactional dependence between suppliers and their major customers. Unlike traditional internal governance mechanisms, customer concentration primarily influences corporate investment decisions through external transactional relationships and supply chain collaboration (Kwak and Kim 2020; Dong et al. 2021). From the perspective of resource dependence, powerful customers, by virtue of their bargaining power in transactions, often exert significant influence over the resource allocation decisions of suppliers, potentially resulting in resource misallocation for the latter (Petersen and Rajan 1997). Therefore, customer concentration can be regarded as a critical factor embedded within the supply chain transaction system, the governance implications of which depend on whether competitive pressure or cooperative coordination mechanisms are predominant.

From the perspective of competitive pressure, an increase in customer concentration undermines suppliers' bargaining power in transactions. According to transaction cost theory and incomplete contract theory, when a supplier's revenue becomes overly dependent on a small number of customers or requires relationship-specific investments, the firm is more susceptible to "hold-up" risks and contractual frictions (Ahsan et al. 2023; Liang 2025). Major customers may leverage their transactional advantage to demand price reductions and extended payment terms, thereby shifting part of the operational risk onto the supplier (Dhaliwal et al. 2016; Campello and Gao 2017). Such pressures compress suppliers' cash flows and restrict their capacity to invest in sustainable development projects.

This issue is particularly pronounced under China's market economy system. Ni et al. (2023) find that customer concentration exacerbates financing constraints for upstream firms by enhancing the bargaining power of downstream customers. At the same time, customer concentration may also alter corporate risk-taking behavior, making suppliers more vulnerable to cost transfers imposed by key customers and undermining the stability of their capital structure (Zu et al. 2024). Therefore, when customer concentration is at a low to moderate level, suppliers' dependence on major customers gradually increases, while stable cooperative governance mechanisms may not yet be fully developed. In this stage, the bargaining effect is more likely to dominate, causing firms to deviate from optimal investment policies and exacerbating investment inefficiency.

Specifically, customer concentration may distort investment efficiency through both underinvestment and overinvestment. On one hand, cash flow pressures and extended

payment cycles may compel suppliers to forgo positive net present value investment opportunities, resulting in underinvestment. On the other hand, in order to maintain key customer relationships, suppliers may overinvest in relationship-specific assets, even if such investments do not effectively enhance firm value. Thus, customer concentration may not only constrain a firm’s normal investment capacity but also induce inefficient investment behavior (Zhang et al. 2020). However, customer concentration does not merely imply competitive pressure. As transactional relationships between suppliers and major customers deepen, cooperative effects may gradually emerge. From the perspective of resource-based relationship theory, inter-firm relationships can generate relational rents through relationship-specific assets and complementary resources (Dyer and Singh 1998). In the context of supply chains, stable relationships with major customers help reduce transaction costs, facilitate process integration, and improve information sharing (Kalwani and Narayandas 1995; Schloetzer 2012; Chen et al. 2021). Through repeated transactions, both parties can build trust, mitigate information asymmetry, and coordinate investment decisions more effectively.

It is important to emphasize that a high degree of customer concentration does not automatically signify mature relational governance. It may also further intensify suppliers’ dependence on major customers and increase their risk exposure. The key lies in whether repeated transactions and relationship-specific investments can establish incentives for both parties to maintain cooperation and coordinate development. When supplier–customer relationships are relatively stable, major customers are more motivated to support suppliers’ ongoing operations, and suppliers can obtain more stable demand expectations. Under such conditions, customer concentration may shift from being merely a source of transactional pressure to functioning as a cooperative governance mechanism. This logic is consistent with the relationship lifecycle perspective: while the early stages of customer relationships may increase relationship-specific investment costs and operational risks, as relationships mature, technology sharing and information transfer may gradually play a positive role (Irvine et al. 2016; Saboo et al. 2017; Liu et al. 2026).

Therefore, the impact of customer concentration is not unidirectional, but may exhibit stage-dependent characteristics. Existing research shows that the negative consequences of customer concentration depend on the supplier’s relative bargaining power and the level of supply chain coordination (Hui et al. 2019; Han et al. 2023; Shen et al. 2018; Krolkowski and Yuan 2017). When customer concentration is at a low to moderate level, transactional dependence is heightened while cooperative governance mechanisms are not yet mature, making customer concentration more likely to exacerbate inefficient investment. As customer concentration increases further and supplier–customer relationships become more stable, the effect of cooperative governance may gradually strengthen, thereby improving the information environment and enhancing capital allocation efficiency. Overall, the effect of customer concentration on investment inefficiency can be understood as the dynamic outcome of the interplay between competitive pressure and cooperative governance mechanisms at different stages of customer dependence. Based on the research framework illustrated in Figure 1, this paper proposes the following hypotheses:

H1:Customer concentration has an inverted U-shaped effect on corporate investment inefficiency; that is, it increases investment inefficiency at lower levels but decreases it at higher levels.

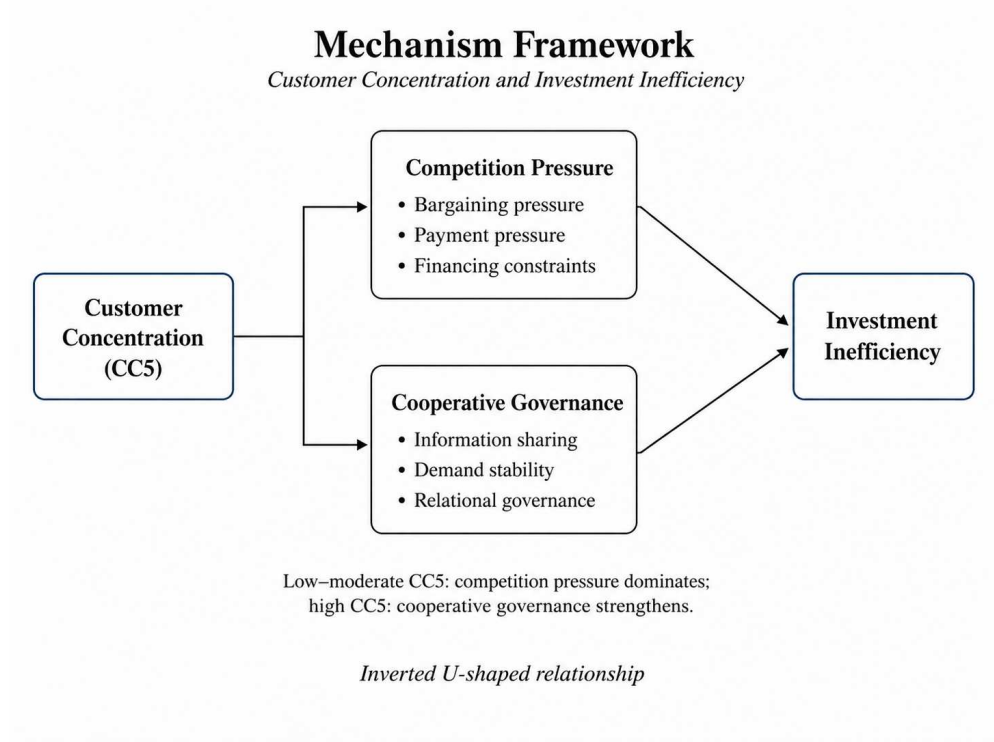


Fig. 1 Mechanism Framework: Customer Concentration and Investment Inefficiency

3 Data and Sample

3.1 Data and Variables

3.1.1 Data Sources

This study initially selects Chinese A-share non-financial listed firms from 2010 to 2022 and further excludes financial firms, delisted firms, ST and *ST firms, and observations with substantial missing values in key variables. To mitigate the influence of outliers on the empirical results, all continuous variables are winsorized at the 1st and 99th percentiles. The final sample consists of 13,560 firm-year observations. All data are obtained from the China Stock Market and Accounting Research (CSMAR) database. Definitions and measurements of all variables are reported in Table 1.

3.1.2 Measures of Customer Concentration

Customer concentration is measured by the ratio of the sales to the top five customers to a firm's annual total sales, denoted as $CC5$ (Dhaliwal et al. 2016; Campello and Gao 2017). Specifically, this study sums the sales generated from a firm's top five customers and then divides the total by the firm's annual sales, thereby capturing the degree of the firm's dependence on its major customers. A higher value of $CC5$ indicates a higher level of customer concentration, whereas a lower value indicates a lower level of customer concentration. This measure is consistent with the China Securities Regulatory Commission's (CSRC) definition of major customers and also aligns with the information disclosure requirements of China's securities market. Therefore, this study uses the following formula to measure customer concentration:

$$CC5_{it} = \frac{\sum_{j=1}^5 Sales_{ijt}}{Sales_{it}} \quad (1)$$

where $Sales_{ijt}$ represents the sales of firm i to customer j in year t , and $Sales_{it}$ denotes the total sales of firm i in year t .

3.1.3 Measures of Investment Efficiency

Following the studies of Richardson (2006) and Zhang et al. (2019), we construct the following model to measure corporate investment efficiency. As shown in Equation (2), the absolute deviation between a firm's actual investment size and the predicted optimal investment size is used to assess investment inefficiency. The larger the absolute deviation, the higher the investment inefficiency and the lower the investment efficiency. Conversely, a smaller absolute deviation indicates lower investment inefficiency and higher investment efficiency. The specific model is as follows:

$$Inv_{i,t} = \beta_0 + \beta_1 Inv_{i,t-1} + \beta_2 Cash_{i,t-1} + \beta_3 Leverage_{i,t-1} + \beta_4 Size_{i,t-1} + \beta_5 Age_{i,t-1} + \beta_6 Growth_{i,t-1} + \beta_7 Ret_{i,t-1} + \sum YearDummy + \sum IndustryDummy + \epsilon_{i,t} \quad (2)$$

- $Inv_{i,t}$ - The level of capital investment for firm i in year t , defined as cash expenditure on fixed assets, intangible assets, and other long-term assets minus cash inflows from the disposal of these assets, standardized by total firm assets.
- $Inv_{i,t-1}$ - Lagged investment level to account for persistence in investment behavior.
- $Cash_{i,t-1}$ - Firm's cash holdings, defined as the ratio of monetary funds to total assets.
- $Leverage_{i,t-1}$ - Firm's leverage ratio, measured as total debt over total assets.
- $Size_{i,t-1}$ - Firm size, proxied by the natural logarithm of total assets.
- $Age_{i,t-1}$ - Firm age, measured as the number of years since listing.
- $Growth_{i,t-1}$ - Firm's growth opportunity, defined as the operating revenue growth rate.
- $Ret_{i,t-1}$ - Annual stock return, considering cash dividend reinvestment.
- $YearDummy$ - Year fixed effects to control for time-specific factors.

- *IndustryDummy* - Industry fixed effects to control for industry-specific characteristics.
- $\epsilon_{i,t}$ - Error term.

Table 1 Variable Definitions

Variable Name	Variable Meaning	Variable Description
INEFF	Inefficient Investment	Absolute residuals of Model (2).
CC5	Customer Concentration	The ratio of sales to the top five customers to total annual sales.
Size	Firm Size	The natural logarithm of the book value of total assets.
Lev	Leverage	Total debt divided by total assets.
Roa	Profitability	Net income scaled by total assets.
Board	Board size	The natural logarithm of the total number of directors on the board.
Top1	Largest Shareholder	The shareholding of the largest shareholder divided by total shares.
Age	Firm age	The natural logarithm of listing years plus 1.
Tobinq	Market Value	The ratio of market value to total assets.
Big4	Big4 auditors	1 if a firm's auditor is one of the Big 4 auditors and 0 otherwise.

3.1.4 Baseline Model

To test the nonlinear relationship between customer concentration and investment inefficiency, this study estimates the following baseline quadratic specification:

$$INEFF_{i,t} = \alpha + \beta_1 CC5_{i,t} + \beta_2 CC5_{i,t}^2 + \sum_k \theta_k Control_{k,i,t} + \delta_j + \lambda_t + \epsilon_{i,t}, \quad (3)$$

where i and t denote firm and year, respectively. $INEFF_{i,t}$ represents investment inefficiency, measured as the absolute residual from the expected investment model. $CC5_{i,t}$ denotes customer concentration, measured as the proportion of sales to the top five customers in total annual sales. $CC5_{i,t}^2$ is the squared term of customer concentration and is included to capture the potential nonlinear effect of customer concentration on investment inefficiency.

$Control_{k,i,t}$ denotes a vector of firm-level control variables, including firm size (*Size*), leverage (*Lev*), profitability (*Roa*), board size (*Board*), ownership concentration (*Top1*), firm age (*Age*), Tobin's Q (*Tobinq*), and Big4 auditor status (*Big4*). δ_j represents industry fixed effects, λ_t represents year fixed effects, and $\epsilon_{i,t}$ is the error term. Standard errors are clustered at the firm level.

4 Research Methodology

Table 2 presents the descriptive statistics of the main variables. The sample includes a total of 13,560 firm-year observations. The mean value of the dependent variable INEFF is 0.0704, and the median is 0.0483, indicating that, overall, the sample firms

Table 2 Descriptive Statistics

Variable	N	Mean	SD	Min	P25	Median	P75	Max
INVEFF	13,560	0.0704	0.0781	0.0009	0.0233	0.0483	0.0860	0.4684
CC5	13,560	0.3023	0.2182	0.0131	0.1357	0.2408	0.4231	0.9578
Size	13,560	22.4591	1.2122	20.2970	21.5830	22.2842	23.1523	26.0032
Lev	13,560	0.4234	0.1924	0.0614	0.2704	0.4183	0.5674	0.8456
Roa	13,560	0.0523	0.0572	-0.1486	0.0211	0.0470	0.0812	0.2140
Board	13,560	2.1331	0.1926	1.6094	1.9459	2.1972	2.1972	2.6391
Top1	13,560	0.3392	0.1482	0.0889	0.2207	0.3187	0.4358	0.7306
Age	13,560	2.8993	0.3153	1.9459	2.7081	2.9444	3.1355	3.5553
Tobinq	13,560	2.1144	1.2794	0.8713	1.2695	1.6967	2.4764	7.7128
Big4	13,560	0.0637	0.2443	0.0000	0.0000	0.0000	0.0000	1.0000

exhibit a certain degree of investment inefficiency, with a minority of firms experiencing relatively high levels of inefficiency. The standard deviation is 0.0781, with a minimum value of 0.0009 and a maximum value of 0.4684, showing significant differences in investment inefficiency levels across firms. The mean value of the key explanatory variable CC5 is 0.3023, suggesting that, on average, the top five customers account for about 30.23% of sales, reflecting a relatively concentrated customer structure among the sample firms. Furthermore, the standard deviation of CC5 is 0.2182, with a minimum of 0.0131 and a maximum of 0.9578, further illustrating substantial variation in customer concentration among firms. The descriptive statistics for other control variables are generally within reasonable ranges.

Table 3 reports the results of the baseline quadratic regression. The results indicate that in both columns (1) and (4), the coefficient of CC5 is significantly positive, while the coefficient of CC5² is significantly negative. This suggests that as customer concentration increases, its marginal effect on investment inefficiency diminishes, ultimately forming an inverted U-shaped relationship. In particular, the results in column (4) show a turning point at 0.6193, implying that before this threshold, rising customer concentration exacerbates inefficient investment by firms; beyond this turning point, further increases in customer concentration gradually weaken and eventually reverse its marginal impact. The Lind–Mehlum test further supports the presence of this inverted U-shaped relationship.

Additionally, Fig. 2 visually illustrates the changing marginal effects before and after the turning point. To the left of the turning point, competitive pressure dominates: rising customer concentration intensifies firms' dependence on major clients and their bargaining pressure, thereby aggravating inefficient investment. To the right of the turning point, collaborative governance mechanisms gradually take precedence; long-term customer relationships and information sharing help to mitigate inefficient investment. Overall, the regression results and graphical evidence jointly support H1.

To further examine the economic significance and statistical stability of the baseline inverted U-shaped relationship, this study reports three additional tests in the Appendix. First, Appendix Table A1 shows that changes in customer concentration have meaningful economic implications for INVEFF. Specifically, the marginal effect of CC5 gradually declines as customer concentration increases and turns negative

Table 3 Baseline regression

	(1)	(2)	(3)	(4)
Variable	INVEFF	INVEFF	INVEFF	INVEFF
CC5	0.0572*** (3.96)	0.0526*** (3.75)	0.0520*** (3.62)	0.0565*** (4.02)
CC5 ²	-0.0440*** (-2.63)	-0.0468*** (-2.83)	-0.0420** (-2.52)	-0.0456*** (-2.74)
Size	0.0024** (2.11)	-0.0001 (-0.10)	0.0009 (0.81)	0.0017 (1.51)
Lev	0.0068 (1.04)	0.0266*** (4.19)	0.0141** (2.23)	0.0217*** (3.33)
Roa	0.0654*** (4.13)	0.0694*** (4.45)	0.0608*** (3.97)	0.0752*** (4.67)
Board	0.0047 (1.00)	0.0025 (0.55)	0.0117** (2.54)	-0.0034 (-0.75)
Top1	0.0092 (1.40)	0.0078 (1.24)	0.0164** (2.52)	0.0036 (0.57)
Age	0.0008 (0.24)	-0.0101*** (-3.57)	-0.0085*** (-2.77)	-0.0002 (-0.06)
Tobinq	-0.0011 (-1.62)	-0.0000 (-0.07)	-0.0005 (-0.77)	-0.0009 (-1.29)
Big4	-0.0055 (-1.31)	-0.0036 (-0.96)	-0.0043 (-1.04)	-0.0047 (-1.22)
Constant	0.0009 (0.04)	0.0750*** (3.14)	0.0275 (1.24)	0.0376 (1.45)
N	13,560	13,560	13,560	13,560
R ²	0.0201	0.0570	0.0087	0.0681
Industry FE	No	Yes	No	Yes
Year FE	Yes	No	No	Yes
Turning point	0.6494	0.5616	0.6192	0.6193
Slope at lower bound	0.0560*** (4.00)	0.0514*** (3.78)	0.0509*** (3.64)	0.0553*** (4.05)
Slope at upper bound	-0.0271* (-1.45)	-0.0371** (-1.95)	-0.0285* (-1.52)	-0.0309* (-1.61)

Notes: This table reports quadratic regression results for the relationship between customer concentration and inefficiency investment. The lower section reports the turning point and Lind-Mehlum-style test statistics for the inverted-U relationship. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

at high levels. Second, Appendix Table A2 further shows, based on the GAM and threshold regression results, that the marginal effect of customer concentration weakens significantly after reaching a certain level, suggesting that the inverted U-shaped relationship is not mechanically driven by the quadratic specification. Finally, the random permutation test reported in Appendix Table A3 shows that the mean permuted coefficients are close to zero, with empirical p -values of 0.000, indicating that the baseline results are unlikely to be generated by random chance. Overall, these appendix results jointly support the robustness of the inverted U-shaped relationship between customer concentration and investment inefficiency.

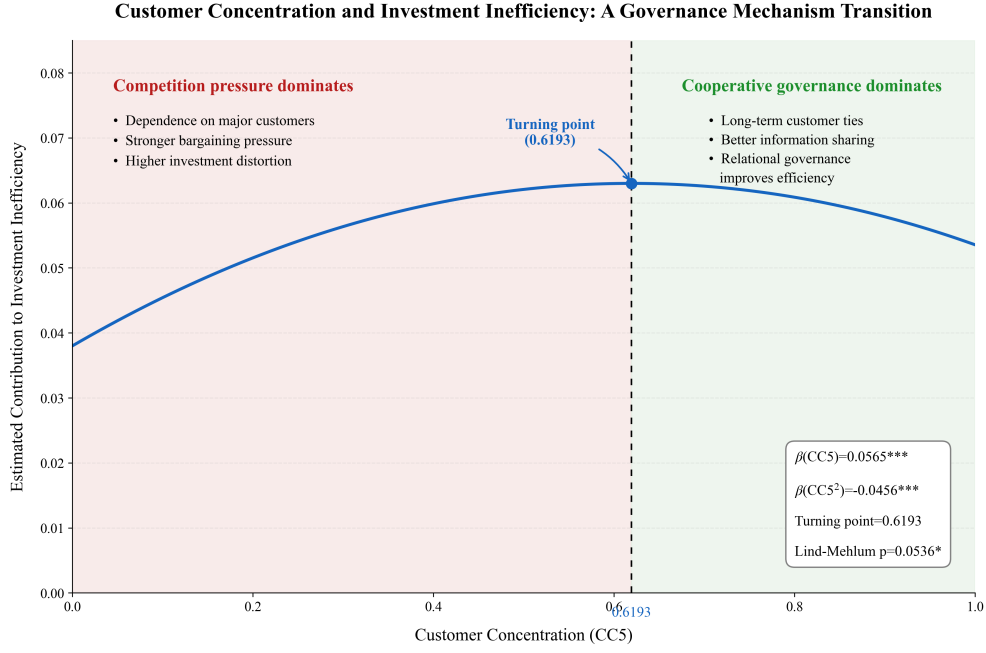


Fig. 2 Customer Concentration and Investment Inefficiency: A Governance Mechanism Transition

Table 4 presents the results of the mechanism analysis. Column (1) shows that $CC5$ is significantly negative, while $CC5^2$ is significantly positive, indicating a U-shaped relationship between customer concentration and analyst coverage. This suggests that customer concentration initially reduces analyst attention by increasing dependence on major customers and worsening the information environment, but analyst coverage gradually recovers when stable long-term customer relationships improve operational predictability.

Column (2) shows that $CC5$ is significantly positive, whereas $CC5^2$ is significantly negative, indicating an inverted U-shaped relationship between customer concentration and customer bargaining power. This implies that customer concentration initially strengthens major customers' bargaining power through greater dependence and payment pressure, but this effect weakens at higher levels of customer concentration as long-term cooperation, lower transaction costs, and more stable contractual arrangements emerge.

Column (3) further shows that $CC5$ is significantly positive and $CC5^2$ is significantly negative, suggesting an inverted U-shaped relationship between customer concentration and financing constraints. This indicates that customer concentration initially increases financing constraints by raising operational and cash flow uncertainty, while stable customer relationships at higher concentration levels help improve market expectations and alleviate financing constraints. Overall, these channel results support the mechanism that competitive pressure dominates at low to moderate levels

Table 4 Economic Channel Tests

	(1)	(2)	(3)
Variables	AnAtt	BP	KZ
CC5	-0.3477** (-2.10)	0.2868*** (5.37)	1.4309*** (4.38)
CC5 ²	0.2994* (1.65)	-0.1932*** (-3.03)	-1.3657*** (-3.82)
Size	0.4362*** (34.28)	-0.0156*** (-3.97)	-0.0573** (-2.24)
Lev	-0.2826*** (-4.22)	-0.0445** (-2.17)	6.7734*** (52.57)
Roa	4.8725*** (26.67)	-0.5562*** (-11.22)	-17.4113*** (-43.26)
Board	0.0439 (0.81)	-0.0178 (-1.09)	-0.0914 (-0.95)
Top1	-0.4468*** (-5.77)	-0.1251*** (-5.28)	-0.7467*** (-5.17)
Age	-0.3555*** (-8.90)	-0.0492*** (-4.07)	0.0686 (0.95)
Tobinq	0.1830*** (20.59)	-0.0033 (-1.28)	0.4613*** (23.33)
Big4	-0.0217 (-0.44)	-0.0018 (-0.16)	-0.2324*** (-2.76)
Constant	-6.7181*** (-21.21)	0.6143*** (6.74)	-0.7380 (-1.22)
N	13,560	13,560	13,560
R ²	0.413	0.377	0.645
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: This table reports the economic channel test results. AnAtt denotes analyst attention and is measured as the natural logarithm of one plus the number of analysts following the firm. BP denotes customer bargaining power and is measured as accounts receivable scaled by operating revenue. KZ denotes financing constraints and is constructed based on operating cash flow, cash dividends, cash holdings, leverage, and Tobin's Q.

of customer concentration, whereas cooperative governance becomes more important at higher levels.

Table 5 reports the results of the decomposition regression for investment inefficiency. Specifically, columns (1) and (2) show that customer concentration exhibits an inverted U-shaped relationship with both over-investment (OverInv) and under-investment (UnderInv). In other words, when customer concentration is at a low to moderate level, an increase in customer concentration simultaneously exacerbates both forms of investment inefficiency—over-investment and under-investment. However, once customer concentration reaches a high level, its marginal effect on both types of investment inefficiency gradually diminishes. This result indicates that the nonlinear impact of customer concentration on investment inefficiency is not confined to a single dimension of investment bias, but manifests in both over- and under-investment. Therefore, the decomposition regression results provide further support

Table 5 Decomposition Regression Results

	(1)	(2)
Variables	OverInv	UnderInv
CC5	0.0672*** (2.98)	0.0503*** (3.75)
CC5 ²	-0.0494* (-1.93)	-0.0446*** (-2.64)
Size	0.0011 (0.64)	0.0017* (1.68)
Lev	0.0555*** (4.76)	-0.0042 (-0.73)
Roa	0.1707*** (5.38)	0.0196 (1.33)
Board	-0.0026 (-0.35)	-0.0072* (-1.73)
Top1	0.0117 (1.13)	-0.0022 (-0.37)
Age	-0.0047 (-0.88)	0.0030 (1.05)
Tobinq	-0.0036** (-2.56)	0.0011* (1.77)
Big4	-0.0076 (-1.31)	-0.0039 (-1.03)
Constant	0.0748* (1.75)	0.0375 (1.52)
Turning Point	0.6798	0.5634
N	5,835	7,725
R ²	0.0664	0.0986
Industry FE	Yes	Yes
Year FE	Yes	Yes

Notes: This table reports the decomposition regression results with *OverInv* and *UnderInv* as dependent variables. Following the Richardson investment expectation model, investment inefficiency is decomposed according to the sign of the residual term: positive residuals are classified as overinvestment and used to construct *OverInv*, while negative residuals are classified as underinvestment and used to construct *UnderInv*. Standard errors are clustered at the firm level. t-statistics are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

for the core conclusion of this paper regarding the inverted U-shaped relationship between customer concentration and firms' investment inefficiency.

Table 6 reports the results of the heterogeneity analysis based on ownership structure and industry characteristics. Columns (1) and (2) show that the inverted U-shaped relationship between customer concentration and investment inefficiency is more pronounced in non-state-owned enterprises compared to state-owned enterprises. This suggests that non-state-owned enterprises are more reliant on market-based transactional relationships, and their investment decisions are more susceptible to the bargaining pressure of key customers and the effects of cooperative governance. Columns (3) and (4) reveal that the inverted U-shaped relationship is mainly present among manufacturing firms, while it is not significant in non-manufacturing firms. This indicates that manufacturing firms operate within tighter supply chain networks,

Table 6 Heterogeneity Analysis of Ownership and Industry

	(1)	(2)	(3)	(4)
Variables	SOE=1	SOE=0	Manufacturing=1	Manufacturing=0
CC5	0.0496** (2.13)	0.0662*** (3.64)	0.0770*** (4.42)	0.0200 (0.86)
CC5 ²	-0.0507* (-1.95)	-0.0454** (-2.05)	-0.0681*** (-3.35)	-0.0093 (-0.34)
Size	-0.0006 (-0.31)	0.0043*** (2.93)	0.0040*** (2.93)	-0.0027 (-1.48)
Lev	0.0317** (2.50)	0.0179** (2.39)	0.0134* (1.68)	0.0359*** (3.17)
Roa	0.0875** (2.31)	0.0598*** (3.29)	0.0382** (1.96)	0.1515*** (5.29)
Board	0.0081 (0.93)	-0.0057 (-1.09)	-0.0089* (-1.72)	0.0066 (0.76)
Top1	0.0153 (1.30)	0.0091 (1.23)	0.0023 (0.31)	0.0090 (0.78)
Age	-0.0017 (-0.27)	0.0022 (0.55)	-0.0038 (-0.95)	0.0082 (1.43)
Tobinq	-0.0019 (-1.17)	-0.0008 (-1.06)	-0.0002 (-0.19)	-0.0022 (-1.61)
Big4	-0.0109** (-2.46)	0.0066 (1.01)	-0.0067 (-1.59)	0.0012 (0.16)
Constant	0.0717 (1.56)	-0.0292 (-0.81)	0.0041 (0.14)	0.0777* (1.83)
Turning Point	0.4887	0.7295	0.5647	1.0738
N	4,553	8,738	9,378	4,182
R ²	0.0996	0.0841	0.0419	0.1232
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Notes: This table reports the heterogeneity analysis across ownership type and industry classification. Columns (1) and (2) present the results for state-owned enterprises and non-state-owned enterprises, respectively. Columns (3) and (4) report the results for manufacturing and non-manufacturing firms, respectively. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

making changes in customer concentration more likely to affect their production planning, order stability, and fluctuations in supply and demand. As a result, the marginal impact of customer concentration on investment inefficiency is more evident in these firms. Overall, the heterogeneity results further demonstrate that the inverted U-shaped effect of customer concentration is more pronounced in firms subject to stronger market constraints and with a higher degree of supply chain dependence.

Table 7 reports the results of the heterogeneity analysis based on market environment. First, the inverted U-shaped relationship between customer concentration and investment inefficiency is primarily observed in the sample of firms with higher market share. This suggests that firms with higher market share generally possess more stable transaction systems and more mature customer structures, making their investment decisions more susceptible to the combined effects of competitive pressure and cooperative governance mechanisms. Moreover, the inverted U-shaped relationship is mainly present in firms with lower institutional investor ownership. This indicates that when

Table 7 Heterogeneity Analysis of Market Environment

Variables	MarketShare		INST	
	High	Low	High	Low
CC5	0.0655*** (3.42)	0.0318* (1.65)	0.0553*** (2.66)	0.0580*** (3.27)
CC5 ²	-0.0563** (-2.43)	-0.0193 (-0.87)	-0.0372 (-1.54)	-0.0534** (-2.41)
Size	0.0032* (1.93)	0.0116*** (5.25)	0.0028* (1.83)	-0.0012 (-0.82)
Lev	0.0394*** (3.99)	0.0129 (1.60)	0.0173* (1.75)	0.0288*** (3.72)
Roa	0.1219*** (4.78)	0.0630*** (3.09)	0.0878*** (3.61)	0.0689*** (3.31)
Board	0.0040 (0.67)	-0.0079 (-1.27)	-0.0050 (-0.71)	-0.0047 (-0.84)
Top1	0.0145 (1.63)	-0.0081 (-1.01)	-0.0117 (-1.20)	0.0063 (0.72)
Age	0.0050 (1.16)	-0.0054 (-1.21)	0.0017 (0.37)	-0.0031 (-0.74)
Tobinq	-0.0006 (-0.55)	-0.0005 (-0.61)	-0.0016* (-1.66)	-0.0005 (-0.56)
Big4	-0.0079* (-1.90)	0.0069 (0.71)	-0.0087* (-1.82)	-0.0010 (-0.15)
Constant	-0.0363 (-0.93)	-0.1521*** (-3.15)	0.0202 (0.53)	0.1049*** (3.01)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Turning Point	0.582	0.823	0.743	0.544
N	7,017	6,543	7,017	6,543
R ²	0.0943	0.0753	0.0804	0.0717

Notes: This table reports the heterogeneity analysis across market environment. MarketShare is measured as a firm's annual operating revenue divided by the total operating revenue of its industry in the same year. INST is measured as the total number of shares held by institutional investors divided by tradable shares. Firms are divided into high and low groups based on the industry-year median. All regressions include the full set of control variables, industry fixed effects, and year fixed effects, with standard errors clustered at the firm level. t-statistics are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

external institutional investor oversight is weaker, firms enjoy greater autonomy in governance, and the impact of customer concentration on investment decisions becomes more pronounced, leading to a more evident marginal effect on investment inefficiency. Overall, these results indicate that the effect of customer concentration is influenced by both the firm's market position and its external governance environment.

Table 8 reports the results of the regression analysis using alternative measures. The results show that regardless of whether customer concentration is measured by the sales share of the largest customer (CC1) or by the squared sum of the sales shares of the top five customers (CC-HHI), the relationship with investment inefficiency follows a pattern of first increasing and then decreasing. This finding indicates that the inverted U-shaped relationship between customer concentration and investment inefficiency does not depend on a single measurement approach, thereby further supporting the robustness of the main conclusion.

Table 8 Robustness Test Using Alternative Measures of Customer Concentration

	(1)	(2)
Variables	INVEFF	INVEFF
CC1	0.0498*** (3.17)	
CC1 ²	-0.0615*** (-2.58)	
CC_HHI		0.0005** (2.15)
CC_HHI ²		0.00001* (-1.69)
Size	0.0011 (1.05)	0.0009 (0.85)
Lev	0.0217*** (3.32)	0.0220*** (3.36)
Roa	0.0730*** (4.53)	0.0719*** (4.46)
Board	-0.0035 (-0.77)	-0.0035 (-0.76)
Top1	0.0031 (0.50)	0.0029 (0.45)
Age	-0.0002 (-0.07)	-0.0003 (-0.09)
Tobinq	-0.0009 (-1.26)	-0.0009 (-1.27)
Big4	-0.0049 (-1.27)	-0.0050 (-1.29)
Constant	0.0535** (2.08)	0.0607** (2.40)
Turning Point	0.4046	33.9392
N	13,560	13,560
R ²	0.0665	0.0659
Industry FE	Yes	Yes
Year FE	Yes	Yes

Notes: This table reports robustness tests using alternative measures of customer concentration. CC1 is measured as the sales share of the largest customer in total sales. CC_HHI is measured as the sum of squared sales shares of the top five customers in total sales. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9 presents the results of the propensity score matching (PSM) analysis. Panel A shows that, prior to matching, there are significant differences between the treatment group and the control group across various covariates. After one-to-one nearest neighbor matching, the differences in most covariates are substantially reduced or become insignificant, indicating that matching has generally improved the comparability between the treatment and control groups. Panel B reports the regression results for the matched sample. In column (1), the coefficient of High-CC5 is 0.0082 and is significant at the 1% level, indicating that after controlling for sample selection bias, the coefficient of CC5 remains significantly positive, and the coefficient of CC5² also

Table 9 Propensity Score Matching Results

Panel A. Covariate Balance Before and After Matching										
Variable	Before Matching					After Matching				
	T Mean	C Mean	Diff	t-value	p-value	T Mean	C Mean	Diff	t-value	p-value
Size	22.3503	22.5686	-0.2183	-10.5303	0.0000	22.4625	22.4271	0.0354	2.9158	0.0036
Lev	0.4146	0.4322	-0.0176	-5.3138	0.0000	0.4259	0.4230	0.0029	0.9279	0.3535
Roa	0.0490	0.0558	-0.0068	-6.9051	0.0000	0.0541	0.0532	0.0009	0.9941	0.3202
Board	2.1273	2.1389	-0.0116	-3.5012	0.0005	2.1352	2.1326	0.0027	0.8099	0.4180
Top1	0.3348	0.3435	-0.0087	-3.4340	0.0006	0.3393	0.3373	0.0020	0.7811	0.4348
Age	2.8923	2.9063	-0.0140	-2.5928	0.0095	2.9012	2.9009	0.0002	0.0418	0.9667
Tobinq	2.1468	2.0792	0.0676	3.0819	0.0021	2.0841	2.1071	-0.0230	-1.0489	0.2943
Big4	0.0540	0.0733	-0.0193	-4.6007	0.0000	0.0589	0.0525	0.0063	1.7089	0.0875

Panel B. Matched-sample Regressions		
Variable	(1)	(3)
	Trend	INVEFF
High-CC5	0.0082*** (4.57)	
CC5		0.0654*** (4.56)
CC5 ²		-0.0549*** (-3.28)
Controls	Yes	Yes
Industry FE	Yes	Yes
Year FE	Yes	Yes
Turning Point		0.5954
95% CI		[0.4525, 0.7383]
Left-side slope		0.0503*** (4.97)
Right-side slope		-0.0398** (-2.08)
N	12,300	12,300
R ²	0.0681	0.0692

Notes: Panel A reports covariate balance before and after propensity score matching. T Mean and C Mean denote the treated-group mean and control-group mean, respectively. Panel B reports matched-sample regressions based on one-to-one nearest-neighbor matching without replacement. t-statistics are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

remains significantly negative. This demonstrates that the inverted U-shaped relationship between customer concentration and investment inefficiency still holds in the matched sample. Overall, the PSM results provide further evidence supporting the robustness of this paper's main conclusion.

Table 10 presents the instrumental-variable regression results. To mitigate potential endogeneity concerns arising from omitted variables, this study follows the approach of (Dhaliwal et al. 2016) and uses the lagged one-period average value of CC5 within the same city-industry cell as the instrumental variable, denoted as L1.CIY-CC5. Its squared term, L1.CIY-CC5², is further constructed as the instrument for CC5².

Table 10 IV-2SLS Regression Results

	(1) First Stage	(2) First Stage	(3) Second Stage
Variables	CC5	CC5 ²	INVEFF
L1.CIY_CC5	0.7585*** (18.46)	11.2285*** (2.87)	
L1.CIY_CC5 ²	0.0001 (0.17)	0.6438*** (12.10)	
CC5			0.0011*** (3.84)
CC5 ²			-0.00001*** (-2.93)
Controls	Yes	Yes	Yes
Constant	40.8983*** (5.34)	2054.7008*** (2.98)	0.0080 (0.25)
First-stage F-stat	1263.3991	913.3224	
N	10,774	10,774	10,774
R ²	0.5723	0.5482	0.0616
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: This table reports the IV-2SLS regression results. Columns (1) and (2) report the first-stage regressions for CC5 and CC5², respectively. Column (3) reports the second-stage regression. The instrumental variables are the lagged one-period average of CC5 within the same City×Industry cell, L1.CIY_CC5, and its squared term, L1.CIY_CC5². The dependent variable in the second stage is INVEFF. All regressions include control variables, industry fixed effects, and year fixed effects. Standard errors are clustered at the firm level. t-statistics are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

The first-stage results show that L1.CIY_CC5 is significantly and positively associated with CC5, while L1.CIY_CC5² is also significantly and positively associated with CC5². These results indicate a strong correlation between the instrumental variables and the endogenous explanatory variables. In addition, the first-stage F-statistics are 1263.3991 and 913.3224, respectively, both far exceeding the conventional threshold of 10, suggesting that weak-instrument concerns are unlikely to be serious. The second-stage results show that, after addressing potential endogeneity, the coefficient on CC5 remains significantly positive, whereas the coefficient on CC5² remains significantly negative, both at the 1% level. These findings further indicate that the inverted U-shaped relationship between customer concentration and investment inefficiency continues to hold in the instrumental-variable specification, thereby supporting the robustness of the baseline conclusion.

Table 11 reports the robustness check results. To mitigate potential simultaneity bias and exclude the possible disturbance caused by the COVID-19 shock, this study conducts two additional tests by using one-period lagged customer concentration and by excluding observations from 2020–2021, respectively. The results show that the inverted U-shaped relationship between customer concentration and investment inefficiency remains significant under both specifications, further supporting the robustness of the baseline conclusion.

Table 11 Robustness Checks

	(1)	(2)
Variables	Lagged CC5	Exclude 2020–2021
Dependent Variable	INVEFF	INVEFF
L.CC5	0.0822*** (5.34)	
L.CC5 ²	-0.0712*** (-3.92)	
CC5		0.0576*** (3.60)
CC5 ²		-0.0449** (-2.36)
Controls	Yes	Yes
Constant	0.0084 (0.29)	0.0404 (1.41)
Turning Point	0.577	0.640
N	10,803	11,148
R ²	0.0763	0.0684
Industry FE	Yes	Yes
Year FE	Yes	Yes

Notes: This table reports robustness checks for the effect of customer concentration on investment inefficiency. Column (1) uses one-period lagged customer concentration, L.CC5 and L.CC5², to mitigate simultaneity concerns. Column (2) excludes observations from 2020 and 2021 to remove the potential influence of the COVID-19 shock. All regressions include control variables, industry fixed effects, and year fixed effects. Standard errors are clustered at the firm level. t-statistics are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

5 Conclusion

From the perspective that competitive pressure and cooperative governance coexist, this study re-examines the impact of customer concentration on corporate investment inefficiency. Unlike the simplistic view that interprets customer concentration solely as a bargaining effect or a win-win cooperation mechanism, this paper emphasizes the phased and dynamic nature of its influence. The empirical results reveal an inverted U-shaped relationship between customer concentration and investment inefficiency, indicating that at different levels, customer concentration may represent two distinct operational modes: competitive pressure and coordinated governance. This finding provides a more dynamic analytical framework for understanding how supply chain relationships affect the efficiency of corporate resource allocation.

The theoretical contributions of this paper are mainly reflected in three aspects. First, by incorporating customer concentration into the analytical framework of corporate investment inefficiency, this study broadens previous research perspectives that have primarily focused on information environment and financing constraints in explaining investment efficiency. Second, this paper uncovers the inverted U-shaped characteristic of the impact of customer concentration on corporate investment decisions, thereby helping to reconcile the divergent viewpoints in existing literature regarding the “bargaining effect” and “cooperative effect” of customer concentration.

Finally, this study further elucidates the mechanism transformation between competitive pressure and cooperative governance through channels such as information sharing, supply-demand fluctuations, and resource allocation, providing more concrete empirical evidence for understanding how customer structure influences corporate investment behavior.

This study offers significant implications for both corporate management and government regulatory agencies. First, for corporate managers, effectively transforming dependence on major clients into stable cooperation and long-term governance represents a crucial approach to enhancing investment efficiency. Second, for investors, a rational assessment of the quality and nature of client structures serves as an important criterion for safeguarding investment efficiency. For regulatory authorities, improving the quality of major client information disclosure and the transparency of supply chain transactions can facilitate the capital market's more accurate identification of the risks and governance value underlying client concentration.

References

- Alkhuzaim, L., Kouhizadeh, M., Sarkis, J.: Resource and natural resource dependence theories in supply chains. In: *Handbook of Theories for Purchasing, Supply Chain and Management Research*, pp. 153–167. Edward Elgar Publishing, ??? (2022)
- Ahsan, T., Mirza, S.S., Gull, A.A., Majeed, M.A.: How to deal with customer and supplier concentration to attain sustainable financial growth? the role of business strategy. *Business Strategy and the Environment* **32**(7), 4600–4619 (2023) <https://doi.org/10.1002/bse.3383>
- Biddle, G.C., Hilary, G.: Accounting quality and firm-level capital investment. *The Accounting Review* **81**(5), 963–982 (2006)
- Biddle, G.C., Hilary, G., Verdi, R.S.: How does financial reporting quality relate to investment efficiency? *Journal of Accounting and Economics* **48**(2-3), 112–131 (2009)
- Bharadwaj, N., Matsuno, K.: Investigating the antecedents and outcomes of customer firm transaction cost savings in a supply chain relationship. *Journal of Business research* **59**(1), 62–72 (2006)
- Chiang, C., Chuang, M.-C.: Effect of sustainable supply chain management on procurement environmental performance: a perspective on resource dependence theory. *Sustainability* **16**(2), 586 (2024)
- Campello, M., Gao, J.: Customer concentration and loan contract terms. *Journal of Financial Economics* **123**(1), 108–136 (2017) <https://doi.org/10.1016/j.jfineco.2016.03.010>
- Chen, F., Hope, O.K., Li, Q., Wang, X.: Financial reporting quality and investment

Table A1 Economic Significance and Marginal Effects

Panel A. Economic Significance				
Comparison	From	To	$\Delta INVEFF$	$\Delta INVEFF/\text{Mean}$
P25 to Median	0.1357	0.2408	0.0041	5.87%
Median to P75	0.2408	0.4231	0.0048	6.79%
P25 to P75	0.1357	0.4231	0.0089	12.66%
P75 to Turning Point	0.4231	0.6193	0.0018	2.49%
Turning Point to Max	0.6193	0.9577	-0.0052	-7.42%
P25 to Max	0.1357	0.9577	0.0054	7.73%

Panel B. Marginal Effects of Customer Concentration		
Location	CC5 Value	Marginal Effect $\partial INVEFF/\partial CC5$
Minimum	0.0131	0.0553
P25	0.1357	0.0441
Median	0.2408	0.0345
P75	0.4231	0.0179
Turning Point	0.6193	0.0000
Maximum	0.9577	-0.0309

Panel C. Distributional Information	
Metric	Value
N	13,560
Mean INVEFF	0.0704
CC5 Minimum	0.0131
CC5 P25	0.1357
CC5 Median	0.2408
CC5 P75	0.4231
CC5 Maximum	0.9577
Estimated Turning Point	0.6193

Notes: This table reports the economic significance and marginal effects implied by the baseline quadratic specification. Panel A presents predicted changes in investment inefficiency when customer concentration moves across selected points of its empirical distribution. Panel B reports the marginal effect of customer concentration evaluated at representative CC5 values. Panel C reports distributional information for CC5 and the estimated turning point. Predicted changes and marginal effects are calculated using the estimated coefficients from the baseline quadratic model.

efficiency of private firms in emerging markets. *The Accounting Review* **86**(4), 1255–1288 (2011)

Chen, X., Liu, C., Liu, F., Fang, M.: Firm sustainable growth during the covid-19 pandemic: The role of customer concentration. *Emerging Markets Finance and Trade* **57**(6), 1566–1577 (2021)

Cai, J., Sharkawi, I., Taasim, S.I.: How does digital transformation promote supply chain diversification? from the perspective of supply chain transaction costs. *Finance Research Letters* **63**, 105399 (2024)

Table A2 Flexible Nonlinearity Robustness Tests

Panel A. Generalized Additive Model (GAM)	
Metric	Value
GAM pseudo-R ²	0.0670
GAM AIC	-31,438.1661
Panel B. Threshold Regression	
Method	Value
Optimal Threshold	$\gamma = 0.22$
CC5 slope below threshold	+0.0518** ($t = 2.39$)
CC5 slope change above threshold	-0.0526** ($t = -2.32$)
CC5 total slope above threshold	-0.0009 ($t = -0.13$)
N	13,560
R ²	0.0693
Controls	Yes
Industry FE	Yes
Year FE	Yes
Clustered by Code	Yes

Notes: This table reports the robustness tests for the nonlinear relationship between customer concentration and investment inefficiency. Panel A presents the generalized additive model (GAM) results, where CC5 is flexibly modeled using a P-spline function while control variables, industry fixed effects, and year fixed effects are included linearly. Panel B reports the threshold regression results. The optimal threshold γ is selected by minimizing the residual sum of squares (RSS). The coefficient reported for “CC5 slope below threshold” captures the marginal effect of CC5 below the threshold, while “CC5 slope change above threshold” reflects the change in slope after crossing the threshold. “CC5 total slope above threshold” is the sum of the below-threshold slope and the slope change above the threshold. All regressions include control variables, industry fixed effects, and year fixed effects, with standard errors clustered at the firm level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A3 Placebo Test

Statistic	β_1 (CC5)	β_2 (CC5²)
Actual coefficient	0.0565	-0.0456
Mean permuted coefficient	0.0002	-0.0004
Empirical p -value	0.000***	0.000***
Permutation repetitions	500	
Valid draws	500	
Controls	Yes	
Industry FE	Yes	
Year FE	Yes	

Notes: This table reports the placebo test based on 500 random permutations. In each iteration, CC5 is randomly shuffled to break its true association with investment inefficiency, and the quadratic regression is re-estimated. The empirical p -value is calculated as the proportion of permuted coefficients whose absolute values are greater than or equal to the absolute value of the actual coefficient. *** denotes significance at the 1% level.

- Dhaliwal, D., Judd, J.S., Serfling, M., Shaikh, S.: Customer concentration risk and the cost of equity capital. *Journal of Accounting and Economics* **61**(1), 23–48 (2016) <https://doi.org/10.1016/j.jacceco.2015.06.004>
- Dong, Y., Li, C., Li, H.: Customer concentration and M&A performance. *Journal of Corporate Finance* **69**, 102021 (2021) <https://doi.org/10.1016/j.jcorpfin.2021.102021>
- Dyer, J.H., Singh, H.: The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *The Academy of Management Review* **23**(4), 660–679 (1998) <https://doi.org/10.2307/259056>
- Fabbri, D., Klapper, L.F.: Bargaining power and trade credit. *Journal of Corporate Finance* **41**, 66–80 (2016) <https://doi.org/10.1016/j.jcorpfin.2016.07.001>
- Hui, K.W., Liang, C., Yeung, P.E.: The effect of major customer concentration on firm profitability: Competitive or collaborative? *Review of Accounting Studies* **24**, 189–229 (2019) <https://doi.org/10.1007/s11142-018-9469-8>
- Han, Z., Yu, C., Li, Y., Shi, J., Liu, Y.: Customer concentration and supplier financial performance: An inverted u-shaped relationship. *Industrial Marketing Management* **113**, 138–152 (2023) <https://doi.org/10.1016/j.indmarman.2023.06.003>
- Irvine, P.J., Park, S.S., Yıldızhan, Ç.: Customerbase concentration, profitability, and the relationship life cycle. *The Accounting Review* **91**(3), 883–906 (2016)
- Kwak, K., Kim, N.: Concentrate or disperse? the relationship between major customer concentration and supplier profitability and the moderating role of insider ownership. *Journal of Business Research* **109**, 648–658 (2020) <https://doi.org/10.1016/j.jbusres.2019.09.033>
- Kalwani, M.U., Narayandas, N.: Long-term manufacturer-supplier relationships: Do they pay off for supplier firms? *Journal of Marketing* **59**(1), 1–16 (1995)
- Krolkowski, M., Yuan, X.: Friend or foe: Customer-supplier relationships and innovation. *Journal of Business Research* **78**, 53–68 (2017) <https://doi.org/10.1016/j.jbusres.2017.04.023>
- Liang, J.: The effect of customer and supplier concentration on firm productivity: The moderating role of the firm’s dominant position in the supply chain network. *International Journal of Production Economics*, 109727 (2025) <https://doi.org/10.1016/j.ijpe.2025.109727> . Available online 2 July 2025
- Lee, S.M., Jiraporn, P., Song, H.: Customer concentration and stock price crash risk. *Journal of Business Research* **110**, 327–346 (2020)

- Liu, C., Wang, Z., Lin, Y.-E.: Invest for customer: Customer orientation and investment efficiency. *Research in International Business and Finance* **88**, 103455 (2026) <https://doi.org/10.1016/j.ribaf.2026.103455>
- McNichols, M.F., Stubben, S.R.: Does earnings management affect firms' investment decisions? *The Accounting Review* **83**(6), 1571–1603 (2008) <https://doi.org/10.2308/accr.2008.83.6.1571>
- Ma, X., Wang, W., Wu, J., Zhang, W.: Corporate customer concentration and stock price crash risk. *Journal of Banking & Finance* **119**, 105903 (2020) <https://doi.org/10.1016/j.jbankfin.2020.105903>
- Ni, J., Cao, X., Zhou, W., Li, J.: Customer concentration and financing constraints. *Journal of Corporate Finance* **82**, 102432 (2023) <https://doi.org/10.1016/j.jcorpfin.2023.102432>
- Patatoukas, P.N.: Customer-base concentration: implications for firm performance and capital markets. *The Accounting Review* **87**(2), 363–392 (2012) <https://doi.org/10.2308/accr-10297>
- Paulraj, A., Chen, I.J.: Environmental uncertainty and strategic supply management: a resource dependence perspective and performance implications. *Journal of Supply Chain Management* **43**(3), 29–42 (2007)
- Petersen, M.A., Rajan, R.G.: Trade credit: Theories and evidence. *The Review of Financial Studies* **10**(3), 661–691 (1997) <https://doi.org/10.1093/rfs/10.3.661>
- Pan, J., Yu, M., Liu, J., Fan, R.: Customer concentration and corporate innovation: Evidence from china. *The North American Journal of Economics and Finance* **54**, 101284 (2020)
- Richardson, S.: Over-investment of free cash flow. *Review of Accounting Studies* **11**(2–3), 159–189 (2006)
- Schloetzer, J.D.: Process integration and information sharing in supply chains. *The Accounting Review* **87**(3), 1005–1032 (2012) <https://doi.org/10.2308/accr-10216>
- Saboo, A.R., Kumar, V., Anand, A.: Assessing the impact of customer concentration on initial public offering and balance sheet-based outcomes. *Journal of Marketing* **81**(6), 42–61 (2017) <https://doi.org/10.1509/jm.16.0457>
- Shen, H., Xia, N., Zhang, J.: Customer-based concentration and firm innovation. *Asia-Pacific Journal of Financial Studies* **47**, 248–279 (2018) <https://doi.org/10.1111/ajfs.12210>
- Zhang, H., An, R., Zhong, Q.: Anti-corruption, government subsidies, and investment efficiency. *China Journal of Accounting Research* **12**(1), 113–133 (2019)

- Zhang, H., Lin, Z., Liu, M., Wang, K.: Customer concentration and over-investment. *Applied Economics* **52**(46), 5035–5045 (2020)
- Zu, Y., Zheng, Q., Qiao, M., Zeng, X.: Customer concentration and company risk-taking: Effective contract or managerial power? *Managerial and Decision Economics* **45**(2), 860–879 (2024) <https://doi.org/10.1002/mde.4037>