Case Customer Concentration and Business Performance in High-Tech Firms: Exploring the Role of Innovation and Digital Transformation

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Abstract. In the face of intensifying global technological rivalry, achieving a balanced customer base and robust operational success are now critical elements for the enduring growth of technology-driven companies. This research explores how the focus on a limited number of clients influences the operational success of technology-driven enterprises, based on information from firms registered on China's Science and Technology Innovation Board from 2019 to 2023. It also explores how innovation and digital transformation play intermediary and regulatory roles, respectively. The findings suggest that an overreliance on a few customers substantially hinders business performance, but digital transformation can notably mitigate this adverse impact. This study offers crucial perspectives for the administration of technology-driven companies and the development of governmental policies.

Keywords: Customer Concentration, Business Performance, Innovation, Digital Transformation.

1 Introduction

In the current era of global technological rivalry, advanced industries are now pivotal in securing a nation's competitive edge, and China is vigorously fostering the growth of its cutting-edge businesses. In this fierce market rivalry, adeptly managing key accounts stands out as a crucial element that allows technology companies to secure a lasting edge and enhance their overall business outcomes. Simultaneously, the Chinese government has implemented a range of initiatives, such as the strategy for innovation-driven growth and the plan for digital transformation, aimed at fostering economic expansion and enhancing the quality of development. These regulations impose fresh demands on the operational frameworks and inventive approaches of technology-driven companies.

For Chinese high-tech companies looking to enhance their business performance, a major challenge is mitigating the risks linked to over-reliance on a few key customers while also adopting innovative trends and digital transformation. Previous studies have delved into multiple elements that impact business performance, such as technological

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B. Siuta-Tokarska et al. (eds.), *Proceedings of the 2025 3rd International Academic Conference on Management Innovation and Economic Development (MIED 2025)*, Advances in Economics, Business and Management Research 348,
https://doi.org/10.2991/978-94-6463-835-6_4

advancements (Zhang et al., 2024 [1]; León et al., 2024 [2]; Jenkinson et al., 2024 [3]), strategic planning (Zhai et al., 2023 [4]; Al-Shukri & K S, 2024 [5]), and the management of human resources (Chowdhury et al., 2022 [6]; Zahrani, 2024 [7]), to name a few. Nonetheless, studies focusing on the impact of customer concentration are still scarce. This aspect plays a crucial role in corporate governance, significantly shaping a company's success. A high level of concentration can lead to steady income but also heightens reliance on key clients. Conversely, a lower concentration mitigates risk by spreading it across a broader base, albeit at the expense of higher operational overheads. The majority of research tends to concentrate on the broader market, with comparatively little attention paid to high-tech companies.

This research investigates how the concentration of customers influences the operational success of high-tech companies in China, and it also delves into the intermediary effect of innovation and the regulatory impact of digital transformation.The research provides the following key contributions: First, it offers a innovative research perspective by enriching the literature on the factors influencing business performance in high-tech firms from the standpoint of customer concentration. Second, it presents a novel theoretical insight by revealing how innovation impacts the connection between customer focus and company success. Ultimately, the results offer valuable practical insights for both businesses and governmental bodies.

2 Theoretical Analysis and Research Hypotheses

2.1 Customer Concentration and Business Performance of High-Tech Enterprises

In the context of high-tech companies, a significant factor contributing to poor business outcomes is an over-reliance on major clients. This reliance tends to exacerbate financial constraints and elevate costs, ultimately leading to a decline in gross profit margins (Kim et al., 2023 [8]). Research has found that, on the one hand, high customer concentration gives customers too much power in negotiations, leading to lower transaction prices and, consequently, a decline in gross profit margins. On the other hand, excessive customer concentration means that demand fluctuations from a few key customers can affect the stability of a high-tech firm's profits. Specifically, the fast product turnover and demand fluctuations in the high-tech industry mean that the loss of key large customers can easily trigger the risk of specialized investment (Cao et al., 2023 [9]). According to cost stickiness theory, under high customer concentration, the negative correlation between the sales share of key customers and the cost stickiness of enterprises is amplified (Zheng et al., 2024 [10]). A decline in business from key customers would increases sunk costs, which seriously affects profit stability (Wei et al., 2024 [11]). Drawing from the preceding examination, this study puts forward the subsequent conjecture.

H1: Excessive customer concentration in high-tech enterprises negatively impacts business performance.

2.2 Mediating Role of Innovation

The business performance of high-tech companies tends to improve with increased innovation. On the one hand, innovation contributes to cost reduction and efficiency improvements within the enterprise, thereby enhancing business performance by increasing productivity and reducing costs (Corallo et al., 2023 [12]). Conversely, innovation enhances the company's reputation and sends favorable messages to stakeholders, thereby facilitating access to external resources and establishing a strong base for enhancing business performance (Arsanti et al., 2024 [13]). However, an overreliance on a few key customers can stifle innovation. This is because a high concentration of customers can create a "resource bottleneck" that hampers creative efforts. Firms become more focused on short-term financial gains to satisfy the expectations of large customers, directing resources toward meeting the self-interested needs of existing customers rather than investing in innovation (Li et al., 2023 [14]). Conversely, companies that rely heavily on a small number of clients generally opt for more cautious approaches to risk management. Innovation is a protracted endeavor that demands substantial investment, yields gradual outcomes, and carries significant uncertainty. Consequently, companies with a concentrated customer base tend to favor cautious innovation approaches. Thus, it is evident that a high level of customer concentration has a detrimental impact on innovation. Consequently, this study puts forward the following hypothesis.

H2: High customer concentration in high-tech enterprises negatively impacts innovation, which in turn reduces business performance.

2.3 Moderating Effects of Digital Transformation

Digital transformation helps reduce customer concentration in high-tech firms by radically changing their business models. First, digital transformation aids in expanding the customer base. Through online channels, firms can reach a broader range of potential customers and extend their market reach (Varadarajan et al., 2022 [15]), which in turn reduces customer concentration. Second, digital transformation helps firms respond more quickly to changes in consumer demand, making timely adjustments to retain existing customers and attract new ones. By reducing information asymmetry through multi-channel communication, digital transformation helps firms better understand market dynamics and adapt their strategies to secure their current clientele and capture new market segments (Talaoui et al., 2023 [16]), thus increasing customer diversity. Finally, digital transformation lowers customer acquisition costs and improves the efficiency of new customer recruitment. Through digital channels, firms can reach more potential customers at lower costs, using customer data analysis to optimize supply and demand matching, thereby improving recruitment efficiency (Tseng, 2023 [17]). Thus, this study posits that digital transformation may enable high-tech companies to diversify their customer base. To encapsulate, the following hypothesis is put forth.

H3: Digital transformation can mitigate the negative impact of customer concentration on business performance.

Digital evolution lessens the adverse effects of a concentrated customer base on business outcomes by fostering innovation. Mechanistically, digital transformation primarily fosters innovation by improving firms' information-sharing and integration capabilities. On the one hand, digital transformation significantly boosts internal communication and data exchange within the organization. It facilitates data integration and real-time updates, which improves communication efficiency and quality, strengthens collaboration, and enhances internal control effectiveness (Shaik et al., 2024 [18]), giving the enterprise a competitive advantage in its innovation activities. Conversely, digital transformation enhances the ability to integrate data, facilitating a cooperative innovation framework, which in turn boosts the effectiveness of innovative processes. Innovation is often a cross-industry and cross-field activity (Mubarak et al., 2023 [19]), and digital transformation improves firms' ability to integrate information, enabling the integration and reconstruction of technology and knowledge across different industries and fields (Yildiz et al., 2024 [20]), thereby enhancing R&D success rates and the transformation rate of innovation outcomes. Based on these points, this paper predicts that digital transformation positively moderates the mediating role of innovation. Consequently, this document puts forward the subsequent proposition.

H4: Digital transformation mitigates the negative impact of customer concentration on business performance by promoting innovation.

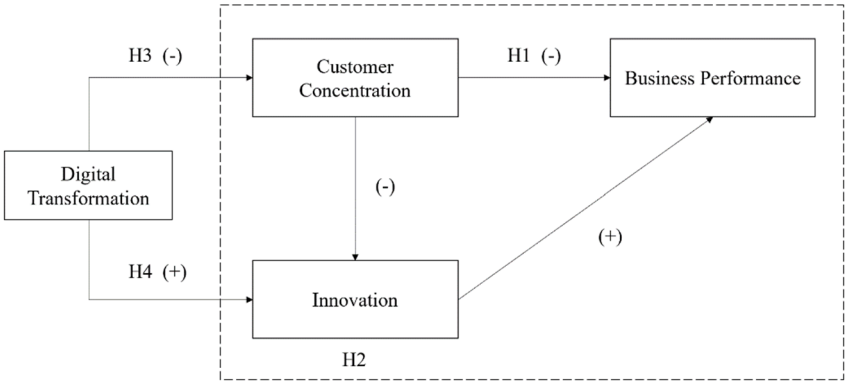

Fig. 1. Research Framework.

The theoretical framework integrating the above hypotheses is visualized in Figure 1.

3 Theoretical Analysis and Research Hypotheses

3.1 Sample Selection and Data Sources

This research focuses on publicly traded firms listed on the China Science and Technology Innovation Board from 2019 to 2023 as the sample for analysis. The sample

undergoes the following processing: any irregular samples, including those labeled as ST and *ST, are eliminated; additionally, samples with substantial data gaps are discarded. Ultimately, 1,806 valid company-year data points are gathered. The primary sources for this research include the China Stock Market & Accounting Research Database (CSMAR) and an analysis of word frequencies from the annual reports of publicly traded companies.

3.2 Variables

The primary outcome measure for this research is the company's financial efficiency, as indicated by its return on assets (ROA). Following the methodology of Rahman et al. (2023 [21]), this paper uses return on total assets to measure business performance.

The primary explanatory factor in this analysis is the level of customer concentration, denoted as CHHI. Following the methodology outlined by Patatoukas (2012 [22]), this research employs the Herfindahl-Hirschman Index, calculated from the sales revenue of a company's top five clients, to quantify the degree of customer concentration.

The mediating variable in this study is innovation performance (Invia). A dummy variable is created to identify firms that applied for invention patents in the current year. It is marked as 1 if patents were filed, and 0 if no patents were filed.

The moderating factor in this study is the extent of digital transformation (DCG). Drawing from the methodology of Wu Fei and colleagues (2021), the level of digital transformation is assessed by analyzing the frequency of related terms. Key terms from domains such as big data, AI, cloud services, blockchain, and digital tech applications are gathered, sorted, and combined to generate the ultimate aggregated word counts.

Moreover, several control variables are chosen based on prior research (Zhai et al., 2022; Cao et al., 2023; Zheng et al., 2024): the firm's size (Size), calculated as the natural logarithm of total assets; the leverage ratio (Lev), defined as the proportion of total liabilities to total assets; growth (Growth), determined by the overall growth rate of operating income; a duality indicator (Dual), set to 1 if the board chairman also serves as the CEO, and 0 otherwise; the fraction of independent directors (Indep), representing the share of independent directors among all directors; the receivables-to-assets ratio (REC), which is the proportion of accounts receivable to total assets; and years on the market (YOM), indicating the duration for which the company has been publicly listed.

3.3 Empirical Model

To assess the influence of customer concentration on business outcomes, the subsequent econometric model is employed for analysis:

$$ROA_{i,t} = \beta_0 + \beta_1 CHHI_{i,t} + \sum \delta_k \, Controls_{i,t} + \sum_{j=1}^{n} Industry_j + \sum_{t=1}^{m} Year_t + \varepsilon_{i,t}$$

The dependent variable $ROA_{i,t}$ represents business performance. The independent variable $CHHI_{i,t}$ signifies the level of customer focus. Controls indicate the chosen

regulatory factors in this analysis. Industry accounts for sector-specific constants, Year adjusts for temporal variations, and ε symbolizes the stochastic disturbance.

4 Empirical Analysis and Results

4.1 Descriptive Statistics

Table 1. Descriptive Statistics.

Variable	N	Mean	SD	Min	Max
ROA	1806	0.0508	0.1146	-1.2347	0.9686
CHHI	1806	0.0978	0.1374	0.0001	1
Invia	1809	0.9210	0.2699	0	1
DCG	1808	2.2602	1.5683	0	5.0370
Size	1806	21.6403	0.9221	17.8790	26.4439
Lev	1806	0.2618	0.1766	0.0156	1.2228
Growth	1806	0.5522	4.1345	-0.9123	168.4032
Dual	1806	0.5620	0.4963	0	1
Indep	1806	0.3755	0.0501	0.2223	0.7273
REC	1806	0.1239	0.0911	0	0.5619
YOM	1806	1.5299	2.4653	0	25

Table 1 provides an overview of the key variables analyzed in this study. The data shows that the average return on assets (ROA) is 0.0508, and the standard deviation is 0.1146, indicating a notable disparity in financial performance across different companies. The average customer concentration stands at 0.0978, and with a standard deviation of 0.1374, this suggests a significant variation in customer concentration among different companies. Additional variables are detailed in Table 1.

4.2 Benchmark Regression

Table 2. Impact of Customer Concentration on Firms' Business Performance.

VARIABLES	(1) ROA	(2) ROA
CHHI	-0.152***	-0.152***
	(-3.90)	(-4.47)
Size		0.026***
		(3.70)
Lev		-0.235***
		(-6.03)
Growth		-0.002***
		(-6.36)
Dual		-0.007

		(-1.46)
Indep		0.007
		(0.10)
REC		0.187***
		(4.03)
YOM		-0.002**
		(-2.21)
Constant	0.066***	-0.447***
	(16.54)	(-3.07)
Year FE	YES	YES
Industry FE	YES	YES
Observations	1,804	1,804
Adj.R^2	0.106	0.205

Note: t-values are in parentheses. ***, **, and * represent p-values less than 0.01, 0.05, and 0.1, respectively. The same applies to subsequent tables.

Table 2 presents the findings from the regression analysis that investigates the impact of customer concentration on business performance. Column (1) shows the results of a simple univariate regression, whereas column (2) incorporates additional control variables. The findings indicate that the regression coefficients for customer concentration are consistently and significantly negative at the 1% level, supporting the initial hypothesis. Therefore, the study concludes that a rise in customer concentration has an adverse impact on firms' business performance.

4.3 Robustness Tests

Table 3. Robustness Tests.

VARIABLES	(1) ROE	(2) ROE	(3) ROA	(4) ROA	(5) ROA	(6) ROA
CHHI	-0.183***	-0.178***				
	(-3.01)	(-3.58)				
CCD			-0.061***	-0.063***		
			(-4.45)	(-4.59)		
CHHI_19					-0.151***	-0.151***
					(-3.76)	(-4.23)
Controls	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Observations	1,802	1,802	1,797	1,797	1,712	1,712
Adj.R^2	0.0557	0.155	0.107	0.184	0.114	0.201

Table 3 presents the outcomes of the robustness checks. Columns (1)–(2) use return on equity (ROE) as the dependent variable, columns (3)–(4) employ the customer concentration ratio (CCD), calculated as the proportion of sales from the top five customers to total annual sales, and columns (5)–(6) omit data from the year of the COVID-19 pandemic. The findings show that the primary conclusions hold steady even after these robustness tests.

4.4 Mechanistic Analysis and Moderating Effects

Table 4. Mechanistic Analysis and Moderating Effects.

VARIABLES	(1) Invia	(2) ROA	(3) ROA
CHHI	-0.609*	-0.152***	-0.377***
	(-2.16)	(-4.47)	(-3.71)
DCG			-0.009***
			(-4.19)
CHHI*DCG			0.715***
			(2.82)
Controls	YES	YES	YES
Year FE		YES	YES
Industry FE		YES	YES
Observations	1806	1,804	1,803
Adj.R^2		0.205	0.213

Table 4 displays the regression outcomes for both the mechanism and the moderating influences. Column (1) explores the impact of customer concentration on innovation. Columns (2) and (3) illustrate the moderating effects, where column (2) uses a single-variable regression, and column (3) incorporates additional control variables. The results indicate that the regression coefficients for the impact of customer concentration on innovation are notably negative at the 10% significance level, corroborating hypothesis 2. The combined effect of digital transformation and customer focus on business outcomes shows a markedly positive correlation at the 1% significance level, supporting hypotheses 3 and 4. The study concludes that digital transformation not only directly alleviates the adverse effects of customer concentration on business performance but also indirectly diminishes these negative impacts by fostering innovation.

5 Conclusion and Prospect

Successfully handling major clients is crucial for technology companies to secure long-term competitive edges and boost their overall business outcomes. Drawing from the

data of companies listed on China's Science and Technology Board between 2019 and 2023, this study comprehensively examines how the concentration of customers influences the operational performance of technology-intensive enterprises. The findings suggest that a high level of customer concentration adversely impacts the performance of technology companies. Even after conducting multiple robustness checks, the study's conclusions stay consistent. The analysis indicates that a high level of customer concentration primarily hampers business performance by stifling innovation. The analysis of the moderating mechanism reveals that digital transformation can lessen the adverse effects of customer concentration on business performance. Additionally, by fostering innovation, it indirectly reduces the negative impact of customer concentration on business outcomes.

The research outcomes offer these key takeaways for stakeholders. Primarily, companies need to implement diverse strategies to decrease reliance on a limited number of customers, thereby mitigating the adverse impacts on business performance and innovation. Second, both the private sector and public authorities need to vigorously advance digital transition, enabling businesses to alleviate the risks associated with a concentrated customer base, and fully leverage digital tools to foster innovation.

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