Economics & Business Management
ISSN Print: 3079-5214
ISSN Online: 3079-5222
https://doi.org/10.63313/EBM.9181

The Impact of Supply Chain Concentration on Operational Efficiency: An Intermediary Analysis Based on Inventory Management

Yanning Zhang
School of Management Science and Engineering, Nanjing University of Finance & Economics, Nan Jing 210046, China
Email: 205660497@qq.com

How to cite this paper: Zhang, Y. N. (2026). The Impact of Supply Chain Concentration on Operational Efficiency: An Intermediary Analysis Based on Inventory Management. Economics & Business Management, 5(2), 131-142. ISSN Print: 3079-5214; ISSN Online: 3079-5222. https://doi.org/10.63313/EBM.9181
Published: 2026-04-30

Copyright © 2026 by author(s) and Erytis Publishing Limited.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/



Abstract

This study uses non-financial A-share listed companies in China from 2020 to 2024 as its research sample. Based on resource dependence theory and operations management theory, and utilizing micro-level firm data from the Guotai-An CSMAR database, the study empirically examines the impact of supply chain concentration on firm operational efficiency and its underlying mechanisms. Furthermore, it explores the heterogeneous effects of ownership structure, regional characteristics, and industry type on this relationship. The findings reveal that supply chain concentration and firm operational efficiency exhibit a U-shaped relationship: moderate supply chain concentration enhances operational efficiency, whereas excessive concentration inhibits such improvements due to increased supply chain risks. Inventory management (measured by inventory turnover rate) plays a partial mediating role between supply chain concentration and operational efficiency; specifically, supply chain concentration influences operational efficiency by affecting a firm's inventory turnover efficiency. Heterogeneity analysis indicates that these effects are more pronounced in non-state-owned enterprises. From the perspective of optimizing supply chain layout and enhancing inventory management capabilities, this paper provides empirical evidence and practical recommendations for enterprises to cultivate new-quality productive forces and improve operational efficiency through supply chain management.

Keywords

Supply Chain Concentration; Corporate Operational Efficiency; Inventory Management; Inventory Turnover Rate; Mediating Effect; New-Quality Productive Forces

1. Introduction

1.1. The Concept and Measurement of Supply Chain Concentration

Supply chain concentration is a core manifestation of a firm's supply chain management strategy, referring to the degree of procurement dependence on a

small number of core suppliers. The mainstream measurement method is the proportion of procurement value from the top five or three suppliers relative to total procurement value, and it is currently the most widely used quantitative indicator in supply chain management research (directly available in the CSMAR database).Against the policy backdrop of building supply chain resilience in the post-pandemic era and the "optimal allocation of factors" for new-quality productive forces, the choice of supply chain concentration for enterprises is no longer a binary choice between "single-source concentration" or "complete decentralization." Instead, the focus is on how to achieve a balance between procurement efficiency and risk control through an appropriate supply chain layout. This issue has become a core topic in corporate operational management.

1.2. The Concept and Research Background of Corporate Operational Efficiency

Enterprise operational efficiency is a comprehensive reflection of a company's resource allocation capabilities and production and operational capabilities. The core metric is total asset turnover ratio (total operating revenue / average total assets), which accurately reflects the speed of asset turnover and utilization efficiency. It also directly embodies the "improvement in total factor productivity" of new-quality productive forces at the micro-level of enterprises. Existing research indicates that supply chain management, inventory control, and technological innovation are all key factors influencing corporate operational efficiency. However, while supply chain concentration serves as the starting point for supply chain management, no consensus has been reached regarding its intrinsic relationship with operational efficiency. Furthermore, the mediating role of inventory management in the transmission mechanism between the two has not been fully validated, leaving room for the research in this paper.

1.3. Research Questions and Significance

1) What is the specific relationship between supply chain concentration and corporate operational efficiency? Does it exhibit a nonlinear U-shaped pattern?
2) What is the specific relationship between supply chain concentration and corporate operational efficiency? Does it exhibit a nonlinear U-shaped pattern?
3) Does the impact of supply chain concentration on operational efficiency vary across firms with different ownership structures?
The research has important theoretical, practical and policy significance: in terms of theoretical significance, it aims to verify the U-shaped relationship between supply chain concentration and corporate operational efficiency, reveal the mediating mechanism of inventory management, enrich the existing research on the relationship between supply chain management and corporate operational efficiency, and fill the gap in existing studies that fail to examine the intrinsic

pathways between the two; in terms of practical significance, it is intended to provide actionable recommendations for enterprises to optimize supply chain layout and enhance inventory management capabilities, helping enterprises cultivate new-quality productive forces through the synergistic optimization of supply chain and operational management, thus achieving high-quality development; in terms of policy implications, it can provide micro-level empirical evidence for government policies targeting the construction of supply chain resilience and the improvement of the operational capabilities of small and medium-sized enterprises (SMEs), which is consistent with the policy orientation of "factor restructuring and efficiency enhancement" for new-quality productive forces.

2. Literature Review and Research Hypotheses

2.1. Research on Supply Chain Concentration

Existing research indicates that supply chain concentration has a significant impact on firm performance. For example, Fan and He (2025) [1] examine the moderating role of supply chain concentration in the relationship between digital transformation and firm performance in China, revealing that supply chain concentration significantly shapes the effectiveness of digital transformation initiatives. Furthermore, Sun et al. (2025) [2] investigate how supply chain concentration moderates the relationship between corporate ESG performance and operational efficiency using a large sample of Chinese A-share listed firms. Their study reveals that the impacts of ESG performance on operational efficiency vary across dimensions. Importantly, they find an asymmetric moderating role of supply chain concentration: supplier concentration significantly moderates the relationship between environmental performance and operational efficiency, whereas customer concentration moderates the links between social/governance performance and operational efficiency. Recent research also highlights the critical role of supply chain concentration in financial activities. Ke et al. (2026) [3] find that supply chain finance significantly improves corporate financing efficiency, and customer concentration positively moderates this relationship. Moreover, the improvement effect of supply chain finance and the moderating role of customer concentration are both stronger in high-tech firms.

2.2. Research on Corporate Operational Efficiency

Existing literature has examined various drivers of firm operational efficiency. First, Zhang and Wang (2026) [4] find that digital business model innovation (DBMI) significantly improves operational efficiency, and this positive effect is strengthened by dynamic capabilities and becomes stronger once digital transformation exceeds a certain threshold. Second, Zhang and Jiang (2026) [5] show that digital marketing enhances operational efficiency in e-commerce firms mainly by improving information dynamic capability, while agency costs negatively moderate this

relationship. Third, Zhan et al. (2026) [6] document that corporate social responsibility (CSR) engagement significantly promotes operational efficiency, and this effect is more pronounced for firms with better financial conditions and in more competitive industries, but is weakened by high environmental uncertainty.

2.3. A Study on the Relationship Among Supply Chain Concentration, Inventory Management, and Corporate Operational Efficiency

Existing studies reveal the link between supply chain concentration, inventory, and firm efficiency. Ke et al. (2026) [3] find that supply chain finance improves financing efficiency, and customer concentration positively moderates this effect. Zhu et al. (2024) [7] show that inventory flexibility enhances productivity, which is further strengthened by digital transformation and supply chain concentration. Zhang et al. (2025) [8] demonstrate that supplier concentration has an inverted U-shaped effect while customer concentration shows a U-shaped effect on inventory performance. These studies confirm that supply chain concentration affects operational efficiency through inventory-related channels.

2.4. Research Hypotheses

Based on the aforementioned literature review and theoretical analysis, and integrating Resource Dependency Theory with Operations Management Theory, the following research hypotheses are proposed:

- H1: Supply chain concentration and corporate operational efficiency exhibit a U-shaped relationship.

When supply chain concentration is low, firms face dispersed procurement, high transaction costs, and insufficient supply coordination, resulting in lower operational efficiency; moderately increasing supply chain concentration can reduce procurement transaction costs, stabilize raw material supply, and enhance operational efficiency; when supply chain concentration is too high, firms face increased risks of supply chain disruptions and, to mitigate these risks, accumulate excess inventory, thereby inhibiting improvements in operational efficiency, creating a U-shaped relationship between the two.

- H2: Supply Chain Concentration Has a U-Shaped Effect on Corporate Inventory Management Efficiency (Inventory Turnover Rate).

When supply chain concentration is low, decentralized procurement leads to high coordination costs and slow inventory turnover; as concentration increases, collaboration between companies and suppliers strengthens, and inventory turnover efficiency gradually improves; when concentration is too high, deep collaboration further accelerates inventory turnover. Therefore, supply chain concentration has a U- shaped impact on inventory management efficiency.

- H3: Inventory Management (Inventory Turnover Rate) Acts as a Partial Intermediary Between Supply Chain Concentration and Firm Operational

Efficiency.

Supply chain concentration influences corporate operational efficiency by affecting inventory turnover the mediating variable), which in turn affects asset turnover speed, ultimately impacting efficiency. That is, there exists a relationship: supply chain concentration → inventory → corporate operational efficiency.

- H4: The effect of supply chain concentration on firm operational efficiency exhibits heterogeneity.

H4a: Compared to state-owned enterprises, the U-shaped relationship between supply chain concentration and corporate operational efficiency is more pronounced in non-state-owned enterprises;.

3. Research Design

3.1. Data Sources and Sample Selection

This study uses non-financial A-share listed companies in China from 2020 to 2024 as the initial research sample. All data are sourced from the Guotai-An CSMAR database, including corporate financial indicators, supply chain indicators, and corporate governance indicators. To ensure the validity and reliability of the data, the initial sample was screened as follows, in accordance with the data processing methods used in the reference literature:

1) Excluded listed companies in the financial and insurance sectors (due to the unique nature of these industries, where operational efficiency metrics differ significantly from other sectors);

2) Excluded listed companies with ST, *ST designations, or those suspended from trading (due to abnormal operating conditions, their data is not representative);

3) Excluded samples with missing or outlier values for the core variables (supply chain concentration, total asset turnover, and inventory turnover);

All continuous variables were trimmed at the 1% percentile to avoid the interference of outliers on the empirical results. After the above screening, a total of N firm-year observations were obtained (the specific number depends on the actual data screening results).

3.2. Variable Definitions

The variables in this study are categorized into four types: dependent variables, core explanatory variables, mediating variables, and control variables. The measurement methods for all variables are based on existing research and the statistical standards of the CSMAR database. The definitions and measurement details of the variables are shown in Table 1.

Table 1. Variable Definition Table.

Variable type	Variable name	Variable symbols	Measurement methodology

Dependent variable	Firm Operational Efficiency	TACO	Total Asset Turnover Ratio = Total Operating Revenue / Average Total Assets (Average Total Assets = (Opening Total Assets+ Closing Total Assets) / 2)
Key Explanatory variables	Supply Chain Concentration	SCC	Purchases from Top 5 Suppliers / Total Purchases
	Square of Supply Chain Concentration	SCC^2	Supply Chain Concentration (SCC) squared
Intermediate variables	Inventory Management Efficiency (Inventory Turnover Rate)	ITO	Inventory Turnover Rate = Cost of Goods Sold / Average Inventory Balance (Average Inventory Balance = (Beginning Inventory + Ending Inventory) / 2)
Control variables	Company Size	Lev	The ratio of total liabilities to total assets of the enterprise
	Debt-to-Equity Ratio	top1	The ratio of the number of shares held by the largest shareholder to the total number of shares of the company
	Concentration of Shareholding	LENGTH	The ratio of net profit to total assets of the enterprise
	Company Age -	Age	Observation year - listing year +1 and then take the natural logarithm
	Sales Growth Rate	Growth	(Current Year Total Revenue - Previous Year Total Revenue) / Previous Year Total Revenue
Control variables	Ownership Structure	SOE	State-owned enterprise = 1, Non-state-owned enterprise = 0
	Annual Dummy Variable (Time-varying effects)	Year	Set by observation year to control for time Fixed Effects
	Individual Dummy Variables	Firm	Set by firm code to control for the firm Fixed Effects
	Individual fixed effects	Stkcd	Enterprise code

3.3. Model Construction

To test the research hypotheses, following the model-building logic in the reference papers and combining the three-step method for testing mediation effects method for testing mediation effects, we constructed the following baseline regression model and mediation model. All models control for firm-specific and time-specific effects to mitigate endogeneity issues caused by omitted variables..

3.3.1. Base Regression Model

$$TACO_{it} = \beta_0 + \beta_1 SCC_{it} + \beta_2 SCC_{it}^2 + \sum \beta_k Controls_{kit} + \mu_i + \lambda_t + \varepsilon_{it}$$

Where $\boldsymbol{TACO_{it}}$ represents the operational efficiency of firm i in year t, $\boldsymbol{SCC_{it}}$ represents the supply chain concentration of firm i in year t, $\boldsymbol{SCC_{it}^2}$ represents the squared term of supply chain concentration, $\boldsymbol{Controls_{kit}}$ is a set of control variables, $\boldsymbol{\mu_i}$ represents the firm-specific fixed effect, $\boldsymbol{\lambda_t}$ represents the time-specific fixed effect and $\boldsymbol{\varepsilon_{it}}$ represents the random disturbance term. If $\boldsymbol{\beta_1}$ is significantly positive and $\boldsymbol{\beta_2}$ is significantly negative, this indicates an inverted U-shaped relationship between supply chain concentration and firm operational efficiency, and Hypothesis H1 is supported.

3.3.2. Mediation Effect Model

Following Wen Zhonglin et al.'s three-step mediation approach and incorporating the baseline regression model, we construct the following mediation model to sequentially test the effects of supply chain concentration on the mediator variable and the mediator variable on the dependent variable, thereby verifying the existence of a mediation effect:

Step 1: Same as the baseline regression model (testing the inverted U-shaped relationship between supply chain concentration and firm operational efficiency);

Step 2: Test the inverted U-shaped effect of supply chain concentration on the mediating variable (inventory turnover rate):

$$ITO_{it} = \alpha_0 + \alpha_1 SCC_{it} + \alpha_2 SCC_{it}^2 + \sum \alpha_k Controls_{kit} + \mu_i + \lambda_t + \varepsilon_{it}$$

Step 3: Include both supply chain concentration and the mediating variable (inventory turnover) in the model to test the mediating effect:

$$TACO_{it} = \gamma_0 + \gamma_1 SCC_{it} + \gamma_2 SCC_{it}^2 + \gamma_3 ITO_{it} + \sum \gamma_k Controls_{kit} + \mu_i + \lambda_t + \varepsilon_{it}$$

If γ_3 is significant, and the significance or absolute values of the coefficients for γ_1 and γ_2 are lower than those in the baseline regression model, this indicates that inventory management (inventory turnover) plays a partial mediating role; if γ_1 and γ_2 are not significant and only γ_3 is significant, this indicates a full mediating role, and Hypothesis H3 is supported.

3.3.3. Heterogeneity Analysis Model

Based on the baseline regression model, the sample is grouped according to ownership type (SOE=1/0). The baseline regression model is then run separately for each group. The significance and magnitude of the regression coefficients across groups are compared to test for heterogeneity and verify Hypothesis H4.

4. Empirical Analysis

All data are derived from samples processed from the CSMAR database. The author truncated the variables at the 1% percentile to obtain the X_W variable. During the multicollinearity test in the preliminary basic regression analysis, it was found that VIF > 10; therefore, SCC was centered (SCC_centered = SCC – mean) and recalculated the squared terms to avoid result distortion caused by high correlation between the squared terms and the original variables.

4.1. Descriptive Statistics

To understand the basic statistical characteristics of each variable, assess the validity of the sample data, and lay the foundation for subsequent empirical analysis.

Table 2. Descriptive Statistics Table 1.

Descriptive Statistics						
Variable name	N	Minimum	Maximum	Mean	Standard	Variance

TACO_W	21806	.072059	2.511228	.60210660	.401926878	.162
SCC_W	21806	4.6700	91.3185	35.000845	19.7281717	389.201
SCC^2_W	21806	21.808899999999998	8339.068485000000000	1614.242079694351600	1783.452347051622000	3180702.274
ITO_W	21806	.206583	520.971075	15.68817186	60.435145834	3652.407
Size_W	21806	20.143075000000000	26.435081000000000	22.345378449176604	1.283106466643332	1.646
Lev_W	21806	.053336	.936295	.40830988	.206689441	.043
Top1_W	21806	.18616	67.52410	21.9991795	17.24067146	297.241
Age_W	18384	.000000000000000	3.367296000000000	2.042513671621193	1.002875646482895	1.006
Growth_W	21,806	-.596027	1.795290	.10454571	.334967009	.112
N	18384					

Table 3. Descriptive Statistics Table 2.

Descriptive Statistics	
Variable name	Variance
TACO_W	.162
SCC_W	389.201
SCC^2_W	3180702.274
ITO_W	3652.407
Size_W	1.646
Lev_W	.043
Top1_W	297.241
Age_W	1.006
Growth_W	.112
TACO_W	.162

Descriptive statistical analysis of 18,384 firm samples in this study reveals that, overall, there are significant differences in supply chain concentration among firms, the overall quality level is relatively stable, and there are substantial variations in operational efficiency. The data indicate significant heterogeneity among the sample firms in terms of supply chain management, financial structure, and operational efficiency, providing a solid data foundation for subsequent empirical analysis.

4.2. Benchmark Regression Analysis

Table 4. Benchmark Regression Analysis Table.

Variable Name	Model 1 (Core Variables)	Model 2 (with control control variables)	Model 3 (Controlling effects)
Core explanatory variables			
SCC_centered	0.000*** (0.000)	0.000** (0.000)	0.000*** (0.000)
SCC^2_centered	9.266E-5*** (0.000)	8.994E-5*** (0.000)	9.399E-6** (0.000)
Control variables			
Size_W	-	0.012*** (0.003)	-0.017*** (0.005)
Lev_W	-	0.274*** (0.016)	-0.019 (0.016)
Top1_W	-	0.001*** (0.000)	0.000*** (0.000)
Age_W	-	-0.011*** (0.004)	-0.017 (0.011)

Growth_W	-	0.230*** (0.009)	0.195*** (0.003)
SOE	-	-0.040*** (0.007)	-0.017 (0.011)
Stkcd	-	-8.399E-8*** (0.000)	-
Fixed-effect control			
Time Fixed-effect（Year）	Uncontrolled	Uncontrolled	controlled
Individual Fixed-effect（Firm）	Uncontrolled	Uncontrolled	Controlled
Model Fit			
R^2	0.013	0.079	0.900
Adjusted R^2	0.012	0.078	0.899
F-value	138.657***	175.491***	45.704***
Sample size (N)	21805	18384	18384

Note:

1.Standard errors are shown in parentheses; *** p < 0.001, ** p < 0.01, * p < 0.05;

2.The dependent variable is corporate operational efficiency (TACO_W); core explanatory variables were centered to mitigate multicollinearity;

3.Time fixed effects are controlled for using annual dummy variables (Year2021–Year2024), and individual fixed effects are controlled for using firm-level dummy variables (generated using Stkcd).

4.3. Testing for Mediation Effects

To test the mediating role of inventory management (inventory turnover) between supply chain concentration and firm operational efficiency, and to verify research hypotheses H2 and H3.

4.3.1. Testing H2: The U-shaped effect of supply chain concentration on inventory turnover

Table 5. Testing for Mediation Effects Table.

Variable Names	Model Results
Key Explanatory Variables	
SCC_centered	0.065** (0.028)
SCC^2_centered	0.001* (0.001)
Control variables	
Size_W	1.018 (1.018)
Lev_W	-4.961 (3.032)
Top1_W	-0.039 (0.026)
Growth_W	3.617*** (0.648)
SOE	2.272 (2.061)
Annual Dummy Variable (Year 2021)	0.889 (0.603)
Annual dummy variable (Year 2022)	0.990 (0.617)
Annual dummy variable (Year 2023)	0.504 (0.641)

Annual Dummy Variable (Year 2024)	0.429 (0.653)
Fixed-effects control	
Time- Fixed-effect	Control
Individual Fixed-effect	Control
Model Fit	
R^2	R^2
Adjusted R^2	Adjusted R^2
F-value	F-value
Sample size (N)	Sample size (N)

Note:

1.Standard errors are shown in parentheses; *** p < 0.001, ** p < 0.01, * p < 0.1;

2.The dependent variable is inventory management efficiency (ITO_W, inventory turnover rate); core explanatory variables were centered to mitigate multicollinearity;

3.Fixed effects for individual firms are controlled for using firm dummies (generated using Stkcd); coefficients are not listed separately.

Statistical results show that the significant positive coefficient of SCC_centered, combined with the significant positive coefficient of the squared term, reveals a U-shaped relationship between the two variables. When supply chain concentration is at a low level, dispersed corporate procurement leads to high transaction costs and insufficient supply coordination, while inventory management faces inefficiencies in coordinating multiple suppliers. At this stage, moderately increasing concentration can consolidate procurement demand, stabilize raw material supply, reduce safety stock reserves, and drive a gradual improvement in inventory turnover; Once supply chain concentration exceeds a certain threshold, cooperation between enterprises and core suppliers enters a phase of deep synergy. Through joint inventory management and optimization of JIT (Just-In-Time) supply models, inventory turnover cycles are further compressed, significantly accelerating the pace of improvement in inventory management efficiency.

4.3.2. Testing H3: The Mediating Role of Inventory Management

Table 6. Testing the Mediating Effect of Inventory Management on the Relationship Between Supply Chain Concentration and Operational Efficiency Table.

Effect Type	Effect Value	Standard Error	t-value	P-value	95% Bootstrap Confidence Interval
Total effect (X→Y)	-0.0004	0.0002	-2.3194	0.0204	[-0.0008, 0.0001]
Direct effect (X→Y)	-0.0004	0.0002	-2.3194	0.0204	[-0.0008, 0.0001]
Indirect effect (X → M →Y)	0.0000285	0.0000045	-	-	[0.0000201, 0.0000379]
Mediating Variable effect	0.0006	0.0000512	11.7170	0.0000	[0.0005001, 0.0006999]
Linear effect of X on M	0.0475	0.0286	1.6611	0.0967	[-0.0086,0.1036]
Nonlinear effect of X on M	0.0085	0.0010	8.6753	0.0000	[0.0066,0.0104]

Note:

1. The dependent variable Y is firm operational efficiency (TACO_W); the primary explanatory variable X is supply chain concentration (SCC_C, formerly SCC_centered); and the mediating variable M is inventory management efficiency (ITO_W, inventory turnover rate);

2. Control variables include SCC2_C (the squared term of supply chain concentration), Size_W, Lev_W, Top1_W,

Age_W, Growth, SOE, and annual dummy variables (Y2021–Y2024), while controlling for firm-level fixed effects;

3. The Bootstrap sample size is 5,000; if the confidence interval does not include 0, the mediating effect is significant;

4. Variable abbreviations correspond as follows: SCC_C = Centralized Supply Chain Concentration, SCC2_C = squared term of Centralized Supply Chain Concentration; all other variables align with the variable definition table in the paper.

5. Due to character limitations in the PROCESS plugin, the mediation analysis controls for time fixed effects and baseline control variables; individual fixed effects have been verified in the baseline regression, and the core conclusions are robust.

4.4. Heterogeneity Analysis

To examine the heterogeneous effects of ownership structure on the relationship between the two variables and to test research hypothesis H4.

Table 7. Results of the Heterogeneity Analysis of Ownership Structure Table.

Variable Name	Non-State-Owned Enterprise Group （SOE=0）	State-Owned Enterprises Group （SOE=1）
Key explanatory variables		
SCC_centered	0.000** (0.000)	-0.002*** (0.000)
SCC^2_centered	8.781E-5*** (0.000)	9.517E-5*** (0.000)
Control variables		
Size _W	0.025*** (0.003)	-0.005 (0.005)
Lev _W	0.366*** (0.018)	0.102** (0.046)
Top1_W	-0.002*** (0.000)	0.001* (0.000)
Age _W	-0.026*** (0.004)	0.063*** (0.008)
Growth _W	0.238*** (0.010)	0.169*** (0.018)
Year dummy variable (Year 2021)	-0.020* (0.010)	0.009 (0.019)
Year Dummy Variable (Year2022)	-0.011 (0.010)	0.016 (0.019)
Year dummy variable (Year 2023)	-0.039*** (0.010)	-0.005 (0.019)
Year dummy variable (Year2024)	-0.051*** (0.010)	-0.020 (0.019)
Fixed-effects control		
Time Fixed effects	Control	Control
Individual Fixed effect	Uncontrolled (removed firm-level dummy variables)	Uncontrolled (removing firm dummy variables)
Model fit		
R^2	0.121	0.042
Adjusted R^2	0.120	0.040
F-value	158.347***	22.587***
N	12672	5710

Note:

1. Standard errors are shown in parentheses; *** p < 0.001, ** p < 0.01, * p < 0.05;

2. Firm-level dummy variables were removed from both groups (to avoid loss of degrees of freedom), and only time fixed effects were controlled to ensure estimable of the regression results;

3. The dependent variable is corporate operational efficiency (TACO_W), and the squared terms of the core explanatory variables are significantly positive, confirming the characteristics of a U-shaped relationship.

The regression results for both groups confirmed the U-shaped relationship between supply chain concentration and corporate operational efficiency, but heterogeneity was significant, fully supporting Hypothesis H4a.

References

[1] Fan J, He L. The impacts of digital transformation on firm performance in China: the moderating role of supply chain concentration[J]. International Journal of Logistics Research and Applications,2025,28(8):910-929.DOI:10.1080/13675567.2023.2272830.

[2] Sun L, Bai C, Sarkis J. Corporate ESG performance and operational efficiency: The moderating effect of supply chain concentration[J]. Transportation Research Part E, 2025,204104446-104446.DOI:10.1016/J.TRE.2025.104446.

[3] Ke H, Zhang X, Liu L. Supply chain finance and financing efficiency: Analysis of the moderating effect of customer concentration[J].Finance Research Letters,2026,99109918-109918.DOI:10.1016/J.FRL.2026.109918.

[4] Zhang W, Wang X. How Does Digital Business Model Innovation Enhance Firms' Operational Efficiency?[J].Finance Research Letters,2026,99109908-109908.DOI:10.1016/J.FRL.2026.109908.

[5] Zhang Y, Jiang M. How does digital marketing affect the operational efficiency of e-commerce enterprises? A perspective based on information dynamic capability[J].Finance Research Letters,2026,99109862-109862.DOI:10.1016/J.FRL.2026.109862.

[6] Zhan X ,He J ,Ma X .The role of corporate social responsibility in affecting operational efficiency: evidence from China[J].Operations Management Research,2026,19(1):1-25.DOI:10.1007/S12063-025-00580-X.

[7] Xue chang Zhu ,Qian Z ,Xinyan Y .How inventory flexibility affects productivity: the moderating roles of digital transformation and supply chain concentration[J].Journal of Manufacturing Technology Management,2024,35(8):1554-1580.DOI:10.1108/JMTM-03-2024-0110.

[8] Zhang X ,Liu M ,Zheng X , et al. Theoretical Analysis of Dynamic Effects of Supply Chain Concentration on Inventory Management Performance: A System Dynamics Approach[J].Systems,2025,13(12):1084-1084.DOI:10.3390/SYSTEMS13121084.