

THE IMPACT OF DIGITAL SUPPLY CHAIN INTEGRATION ON THE EXPORT PERFORMANCE OF CROSS-BORDER E-COMMERCE ENTERPRISES: THE MEDIATING ROLE OF SUPPLY CHAIN AGILITY AND THE MODERATING EFFECT OF DIGITAL PLATFORM CAPABILITIES

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Abstract: This study explores the relationships among Digital Supply Chain Integration (DSCI), Supply Chain Agility (SCA), Digital Platform Capability (DPC), and Export Performance (EP). Results show that DSCI significantly enhances SCA but has no direct significant impact on EP; SCA positively affects EP and mediates the DSCI-EP relationship; DPC significantly moderates the DSCI-SCA relationship. The findings offer valuable insights for enterprises to optimize supply chain management.

Keywords: Digital Supply Chain Integration, Supply Chain Agility, Digital Platform Capability, Export Performance

Introduction

The market has witnessed a rapid growth trend in recent years. In recent years, according to the United Nations Conference on Trade and Development (UNCTAD), global e-commerce sales have increased several times over the past decade. Especially during the COVID-19 pandemic, online shopping became the mainstream way of consumption, further boosting the rapid growth of cross-border e-commerce. In 2020, global e-commerce sales increased by about 27% year-on-year, reaching approximately \$4.3 trillion, with a significant increase in the proportion of cross-border e-commerce. This growth trend reflects the shift in consumer shopping habits and reveals the substantial role of cross-border e-commerce in global trade. As a vital link connecting global consumers and suppliers, cross-border e-commerce has broken geographical limitations, offering businesses a broader market space. It has also promoted the facilitation of international trade and driven the digital transformation of global

supply chains. Its main characteristics include global market coverage, convenient transactions, product diversity, and cost advantages. As the world's largest e-commerce market, China, the Chinese government has recently introduced a series of support policies to promote the rapid development of cross-border e-commerce. In 2020, the total import and export volume of cross-border e-commerce in China reached 1.69 trillion yuan, a year-on-year increase of 31.1%, with exports reaching 1.12 trillion yuan, a year-on-year increase of 40.1%. Chinese cross-border e-commerce enterprises have further expanded international markets and enhanced the global influence of Chinese brands through cooperation mechanisms such as the "Belt and Road" Initiative.

In traditional supply chain models, untimely information transmission and poor coordination among supply chain links often result in slow response times, inventory overstock, high logistics costs, and low customer satisfaction. These problems are particularly prominent in cross-border e-commerce due to the complex logistics, payment, and compliance requirements involved in cross-border transactions. For instance, information transmission between suppliers and retailers in traditional supply chains may take several days or weeks, leading to lagging inventory management and delayed order fulfillment. With the rapid development of digital technologies such as big data, artificial intelligence, blockchain, and cloud computing, digital supply chain integration has become a key approach to improving efficiency, reducing costs, and enhancing competitiveness. By integrating these technologies, enterprises can achieve real-time data sharing, intelligent forecasting, transparent transactions, and efficient coordination, optimizing supply chain management. Digital supply chain integration (DSCI) refers to enterprises using the main components of DSCI, which include data synchronization, AI-driven logistics, blockchain, transparency, and cloud-based collaboration. By applying these technologies, enterprises can manage their supply chains more efficiently and improve overall operational efficiency.

The global market environment is becoming increasingly complex and volatile, with higher uncertainty in consumer demands and frequent changes in competitors' dynamics. Cross-border e-commerce enterprises need to be able to respond quickly to market changes to maintain their competitive advantages. For example, consumer product demands may change quickly, requiring enterprises to adjust product supply and logistics arrangements swiftly. Supply chain agility (SCA) refers to the ability of a supply chain to rapidly adjust and adapt in the face of demand fluctuations, supply disruptions, or market changes. It encompasses demand responsiveness, supply chain flexibility, inventory management efficiency, and delivery speed optimization. An agile supply chain enables enterprises to better cope with uncertainties, improve customer satisfaction, and enhance market competitiveness. In the context of cross-border e-commerce, supply chain agility is specifically manifested in the ability to adapt to changes in customer orders and preferences quickly, flexibly replace suppliers, logistics partners, and warehousing locations according to market demands, monitor inventory in real-time to reduce overstock and shortages, and optimize last-mile delivery using AI and

real-time tracking technologies. These capabilities are crucial for cross-border e-commerce enterprises as they help maintain competitiveness in the global market.

Research Objective (s)

In today's fiercely competitive business environment, innovation is one of the key factors for business success. For cross-border e-commerce enterprises, the innovation of digital supply chain integration and supply chain agility is crucial for their survival and development. To better understand the relationships among digital supply chain integration, supply chain agility, and export performance, this study aims to achieve the following eight specific objectives:

Objective 1: To investigate cross-border e-commerce employees' perceptions of their company's digital supply chain integration.

Objective 2: To examine cross-border e-commerce employees' perceptions of their company's supply chain agility.

Objective 3: To explore cross-border e-commerce employees' perceptions of their company's innovation performance.

Objective 4: To study cross-border e-commerce employees' perceptions of their company's digital platform capabilities.

Objective 5: To analyze the impact of cross-border e-commerce enterprise characteristics (firm size, export experience, logistics infrastructure) on employees' perceptions of digital supply chain integration.

Objective 6: To assess how cross-border e-commerce enterprise characteristics (firm size, export experience, logistics infrastructure) influence employees' perceptions of supply chain agility.

Objective 7: To evaluate the effect of cross-border e-commerce enterprise characteristics (firm size, export experience, logistics infrastructure) on employees' perceptions of innovation performance.

Objective 8: By achieving the above research objectives, this study aims to analyze the relationships among digital supply chain integration, supply chain agility, digital platform capabilities, and innovation performance. It seeks to reveal the mediating role of supply chain agility and the moderating effect of digital platform capabilities.

Literature Review

Digital Supply Chain Integration and Export Performance

The existing literature emphasizes the key role of digital supply chain integration (SCI) in improving export performance, especially in the context of Industry 4.0 technologies and digital transformation initiatives. Benzidia et al. (2021) highlighted that big data analytics (BDA) and artificial intelligence (AI) have significantly promoted the integration of green supply chain processes, thereby enhancing environmental performance. This indicates that advanced digital tools can facilitate more

sustainable and efficient supply chain operations. Similarly, Abdallah et al. (2021) demonstrated that supply chain integration, including supplier, customer, and internal integration, has a positive impact on supply chain performance (SCP) and export performance (EXP), with SCP acting as a mediating factor. This suggests that effective integration can improve export outcomes.

Patrucco et al. (2021) further explored how Industry 4.0 technologies, including big data analytics, cloud computing, and simulation software, enhance visibility and collaboration between buyers and suppliers. These technologies improve supply chain performance through better integration and coordination, crucial for successful export activities. Empirical evidence indicates that digital tools can facilitate closer relationships between buyers and sellers, supporting export performance.

Recent studies have also emphasized the impact of digital transformation (DT) and digital technologies on export performance. Al-Khatib (2023) confirmed that big data analytics capabilities directly affect export performance, with supply chain agility acting as a moderating factor that strengthens this relationship through supply chain innovation. Oubrahim et al. (2023) extended this understanding by showing that digital transformation and supply chain integration jointly enhance overall sustainable supply chain performance, closely related to export success.

Fanget et al. (2024) conceptualized digital transformation strategies in the supply chain, indicating that DT strategies directly improve financial performance and strategic agility, which are crucial for competitive export performance. Similarly, Shahadat et al. (2023) found that digital technologies can enhance supply chain capabilities, improving performance and competitive advantage, particularly in the garment industry. Dong et al. (2023) also examined the role of digitalization in green and sustainable supply chains. Their research found that digital integration promotes green innovation activities in the green construction supply chain, indirectly supporting sustainable export practices. Salamah et al. (2023) emphasized that digitalization affects supply chain performance in the post-COVID era by enhancing integration and efficiency, which is crucial for maintaining export performance amid market disruptions.

Finally, Lin et al. (2024) highlighted that supply chain integration and digital technologies help improve organizational resilience, supporting sustainable performance and export success. These studies indicate that digital supply chain integration, supported by advanced technologies such as big data analytics, AI, and cloud computing, enhances coordination, agility, sustainability, and resilience within the supply chain, making it a key driver for improving export performance. Thus, we posit that:

H1: Digital supply chain integration has a significant positive effect on the export performance of cross-border e-commerce firms.

The Relationship Between Digital Supply Chain Integration, Supply Chain Agility, and Export Performance

The existing literature emphasizes the crucial role of digital supply chain integration (DSCI) and supply chain agility (SCA) in enhancing supply chain and export performance. Muafi et al. (2022)

highlighted that digital supply chains (DSC) and supply chain integration (SCI) act as mediating variables between green intellectual capital (GIC) and business performance (BP). This underscores the interconnectedness of digital and integrated supply chain practices with overall business success. This suggests that digital integration helps create more agile and responsive supply chains, essential for improving performance metrics.

Al-Khatib (2023) provided empirical evidence that supply chain agility moderates the relationship between supply chain innovation and export performance. This indicates that agility enhances the positive impact of innovative supply chain practices on export outcomes. Similarly, Fang et al. (2023) demonstrated that digital transformation (DT) strategies directly affect strategic agility, positively impacting financial performance. This reinforces the idea that digital initiatives can promote agility, which benefits overall performance, including export success.

Further supporting this view, Meng et al. (2023) explored how digital transformation affects organizational sustainable performance through the mediating role of supply chain agility and integration. Their results indicate that digital initiatives can improve supply chain capabilities, enhancing performance, including export performance. Zhou et al. (2024) extended this understanding by showing that adopting digital technologies positively impacts innovation performance, with supply chain agility and integration acting as mediating factors that amplify this effect. This suggests that digitalization enhances firms' innovation and export capabilities by improving supply chain responsiveness.

Regarding technological tools, Abdul-Azeez et al. (2024) examined how enterprise resource planning systems like SAP S/4HANA streamline supply chain processes and improve visibility and responsiveness, which are crucial for agile and efficient supply chains. Ma et al. (2024) emphasized that big data analytics and AI enhance digital supply chain transformation by strengthening internal and external integration and agility. This is vital for responsiveness and competitiveness in export markets.

Finally, Azher et al. (2025) explored how digital supply chain integration (DSCI) affects firm performance, with knowledge sharing as a mediating variable and environmental turbulence as a moderating variable. Their results further confirm that digital integration, supported by effective knowledge sharing, can enhance firm performance, including export performance, especially in turbulent environments.

Overall, the literature consistently suggests that digital supply chain integration significantly improves supply chain agility, which positively impacts export performance. Digital technologies and strategic digital transformation initiatives are drivers that enhance supply chain responsiveness, innovation capabilities, and overall performance, thereby facilitating better export outcomes (Muafi et al., 2022; Al-Khatib, 2023; Fang et al., 2023; Meng et al., 2023; Zhou et al., 2024; Ma et al., 2024; Azher et al., 2025).

H2: Digital supply chain integration significantly impacts the supply chain agility of cross-

border e-commerce firms.

H3: Supply chain agility has a significant positive impact on the export performance of cross-border e-commerce firms.

H4: Supply chain agility mediates between digital supply chain integration and export performance in cross-border e-commerce firms.

The Relationship Between Digital Supply Chain Integration, Digital Platform Capabilities, and Supply Chain Agility

Integrating digital technologies in the supply chain has significantly affected supply chain agility, a key factor in effectively managing dynamic market conditions. Gohil et al. (2021) emphasized how blockchain integration technology enhances the flexibility and agility of supply chain operations, highlighting the role of digital supply chains in promoting lean and efficient processes across industries. Similarly, Fang et al. (2023) conceptualized digital transformation strategies in supply chain management, showing that digital transformation (DT) directly impacts strategic agility, affecting financial performance. Their findings suggest that digital transformation is a catalyst for improving supply chain responsiveness and adaptability. Additionally, Wang et al. (2022) highlighted the mediating role of supply chain capabilities in leveraging digital innovation. They argued that developing robust supply chain management capabilities is crucial for companies adapting to turbulent environments and achieving sustainable growth. This aligns with the broader understanding that digitalization enhances supply chain agility by improving capabilities. Joglekar et al. (2022) contributed to this discourse by examining how the configuration of digital and physical infrastructure platforms affects supply chain agility, emphasizing the importance of platform configuration at both firm and industry levels. These studies implicitly support the moderating role of digital platform capabilities in the relationship between digital supply chain integration and agility. For instance, Shahadat et al. (2023) demonstrated that digital technologies, including digital platforms, can provide firms with competitive advantages by enhancing supply chain capabilities, which are crucial for agility. Similarly, Dong et al. (2023) explored how digital integration and green knowledge collaboration affect supply chain performance, indicating that the effectiveness of digital integration depends on the ability of digital platforms to facilitate knowledge sharing and innovation. Furthermore, Fang et al. (2023) examined the strategic significance of digital platform capabilities, noting that digital transformation strategies often involving digital platforms can significantly enhance strategic agility and financial outcomes. This suggests that digital platform capabilities play a moderating role, amplifying the positive impact of digital supply chain integration on agility.

In summary, the reviewed literature emphasizes that digital supply chain integration enhances supply chain agility, with digital platform capabilities playing a crucial moderating role. These capabilities enable firms to utilize digital technologies better, improve infrastructure configuration, and develop the abilities needed to rapidly respond to environmental uncertainties, thereby building more

agile and resilient supply chains (Gohil et al., 2021; Fang et al., 2023; Wang et al., 2022; Joglekar et al., 2022; Shahadat et al., 2023; Dong et al., 2023).

H5: Digital platform capabilities significantly moderate the relationship between digital supply chain integration and supply chain agility in cross-border e-commerce firms.

Conceptual Framework

Based on an in-depth analysis of the extensive literature on key elements in cross-border e-commerce, we have identified the complex and valuable relationships among digital supply chain integration, supply chain agility, export performance, and digital platform capabilities. From scholars' diverse perspectives on how digital technologies drive supply chain development across different dimensions and empirical analyses of the mechanisms underlying various variables, we have laid a solid foundation for building a theoretical framework. From this foundation, we have distilled these theoretical insights into several testable hypotheses intuitively presented as a structural conceptual diagram. This framework aims to provide a clear blueprint for subsequent empirical research, enabling an in-depth exploration of the internal driving logic and mechanisms that lead to exceptional export performance in cross-border e-commerce firms. As shown in the figure below, it is well worth further exploring and analyzing how these elements interact to enhance corporate competitiveness.

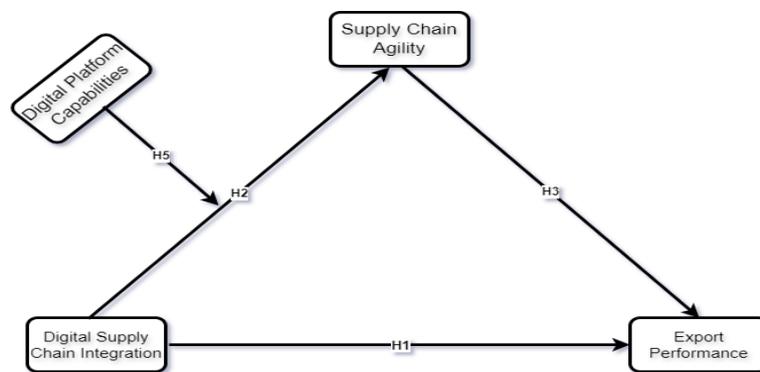


Figure 1: Conceptual Framework

Methodology

Measurement Scales and Design

In this study, all scales are developed in the form of a Likert 5 5-point scale, ranging from "Strongly Disagree" (1 point) to "Strongly Agree" (5 points). When measuring variables, the construction of the digital supply chain integration scale refers to the research results of Kakhki et al. (2023) and Rashid et al. (2024), covering aspects such as digital technology application, real-time data analysis, automation, and AI technologies, technical response capabilities, tool upgrades, customer network connections, and global distribution capabilities; the export performance scale is adapted from

ATABAY (2024), assessing dimensions like overseas sales profitability, sales proportion, trends in profit - making ability, sustained growth, and profit - making ability compared to domestic sales; and the supply chain agility scale is adapted from Shukor et al. (2021), focusing on the enterprise's ability to adapt to changes in customer demand quickly, respond to fluctuations in supplier availability and delivery times, adjust production levels effectively, and manage transportation interruptions. These scales' topic selection and dimension design are based on previous research results and have undergone reliability and validity tests to ensure their scientific and practical nature.

Sample Design and Data Collection

In terms of sample design and data collection, this study focuses on cross-border e-commerce enterprises within China, covering different industries and sizes. Stratified random sampling was adopted to ensure the sampling results were representative. Based on their business models, enterprises were divided into three strata: platform-based e-commerce sellers, direct exporters, and international B2B suppliers. The sample size was determined using classical statistical formulas, considering research precision, overall heterogeneity, and resource constraints, with a final sample size of 462. Questionnaires were distributed via Wenjuanxing, yielding 797 valid responses and a 93.76% valid response rate, ensuring rich and reliable data.

Data Analysis Methods

In this study, the data analysis methods are as follows:

Descriptive statistics: Describe data characteristics, like mean, standard deviation, skewness, and kurtosis.

Correlation analysis: Assess linear relationships between variables using Pearson correlation coefficients.

One-way ANOVA: Test mean differences across groups for a variable.

Welch's test: Test mean differences when group variances are unequal.

Bayesian analysis: Validate Welch's test results by calculating Bayes factors.

Confirmatory factor analysis (CFA): Check the fitness of the measurement model and data.

Structural equation modeling (SEM): Analyze causal relationships and complex path models between variables.

Bootstrap method: Resample data to estimate the significance of mediation and moderation effects.

Results

Demographic Characteristics

This study surveyed 797 enterprises. Figure 1 shows that the sample enterprises are distributed across three key characteristics: firm size, years of operation, and logistics infrastructure.

In terms of firm size, small enterprises with fewer than 50 employee's makeup 21% (164 firms),

those with 51 - 200 employees account for 30% (236 firms), medium-sized enterprises with 201 - 500 employees represent 26% (211 firms), and large enterprises with over 501 employees constitute 23% (186 firms). The sample covers enterprises of various sizes, predominantly medium-sized ones.

Regarding years of operation, enterprises with less than 2 years of experience account for 13% (100 firms), those with 2 - 5 years make up the largest group at 34% (272 firms), 6 - 10-year-old enterprises represent 33% (262 firms), and those with over 10 years of experience account for 20% (163 firms). The sample is dominated by enterprises with intermediate years of operation, including newly established and more mature enterprises.

In terms of logistics infrastructure, only 86 enterprises (11%) are rated as "excellent," 312 (39%) as "good," 284 (36%) as "average," and 115 (14%) as "poor." Most enterprises have logistics infrastructure that is average or below, with only a few reaching excellences, indicating the need for improvement in this area.

Table 1: Frequency of General Information

	Characteristic	N = 797
Firm_Size	Less than 50	164 (21%)
	51-200	236 (30%)
	201-500	211 (26%)
	Over 501	186 (23%)
Exp_Year	Less than 2 years	100 (13%)
	2-5 years	272 (34%)
	6-10 years	262 (33%)
	Over 10 years	163 (20%)
Logistics	Excellent	86 (11%)
	Good	312 (39%)
	Everage	284 (36%)
	Poor	115 (14%)

Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis (CFA) was conducted to assess the reliability and validity of the measurement scales for the four core variables: Market Orientation (MO), IT Capability (ITC), Dynamic Capability (DC), and Competitive Performance (CP). The results indicate high reliability and validity for all scales:

Table 2: Confirmatory Factor Analysis

Variables	Loadings	CA	CR	AVE
Digital Supply Chain Integration		0.9760	0.9760	0.854
1. Our firm uses digital technologies to enhance supply chain coordination.	0.936			
2. We integrate real-time data analytics to improve decision-making in operations.	0.914			
3. We use automation and AI to enhance supply chain efficiency.	0.928			
4. Technology adoption has significantly improved our supply chain responsiveness.	0.926			
5. We continuously upgrade our digital tools to optimize supply chain performance.	0.92			
6. The level of linkage with our major customers through information networks.	0.93			
7. Modify the ability to deliver products worldwide.	0.914			
Supply Chain Agility		0.9670	0.9670	0.854
1. Our overseas sales profitability significantly affects the company's total profitability.	0.923			
2. The share of overseas sales in our total sales is significantly large.	0.916			
3. Our overseas sales profitability has increased over the years.	0.932			
4. Our overseas sales have continually increased over the last 5 years.	0.925			
Export Performance		0.9620	0.9620	0.864
1. We can quickly adapt to changes in customer demand.	0.929			
2. Our supply chain responds well to supplier availability and lead time fluctuations.	0.93			
3. We can adjust production levels effectively to respond to market changes.	0.925			
4. Our supply chain can efficiently redirect shipments during disruptions (e.g., natural disasters or strikes)	0.935			
5. A comparison between our overseas sales and our domestic sales profitability would show that our overseas sales are more profitable.	0.923			
Digital Platform Capabilities		0.9840	0.9840	0.886
1. Our platform easily accesses data from our partners' IT systems.	0.944			
2. Our platform provides a seamless connection between our partners' IT systems and our IT systems.	0.942			
3. Our platform can exchange real-time information with our partners.	0.943			

Variables	Loadings CA CR AVE
4. Our platform easily aggregates relevant information from our partners' databases.	0.937
5. Our platform is easily adapted to include new partners.	0.942
6. Our platform can be easily extended to accommodate new IT applications or functions.	0.944
7. Our platform employs standards accepted by most current and potential partners.	0.934
8. Our platform consists of modular software components, most of which can be reused in other business applications.	0.944

Correlation Coefficients

Correlation analysis was conducted to examine the relationships among the core variables.

Table 3: Correlation Coefficient

Term	Firm _ Size	Exp _ Year	Logistics	DSCI	SCA	EP	DPC
Firm _ Size	1.000						
Exp _ Year	-0.036	1.000					
Logistics	0.016	-0.011	1.000				
DSCI	-0.017	0.260	0.024	1.000			
SCA	-0.011	-0.032	0.122	0.537	1.000		
EP	-0.019	0.040	-0.040	-0.000	0.493	1.000	
DPC	0.214	-0.005	0.011	0.271	0.419	0.217	1.000

Firm size shows weak correlations with other variables. Its correlation coefficient with digital platform capability (DPC) is 0.214, indicating a slight tendency for DPC to 增强 as firms grow larger, yet the relationship is insignificant. Years of experience (Exp_Year) correlate positively with digital supply chain integration (DSCI) at 0.260, suggesting possible DSCI improvements with longer operation, but the correlation is moderate. Exp_Year and logistics infrastructure (Logistics) have a near-zero correlation of -0.011, implying a limited direct impact of experience on logistics.

Logistics and DSCI have a very weak correlation of 0.024, indicating almost no direct linear link. This suggests that logistics improvements may not boost DSCI levels and that different factors likely drive them.

DSCI and supply chain agility (SCA) are positively correlated at 0.537. This means better DSCI can enhance SCA, helping enterprises quickly adapt to market changes and uncertainties. DSCI also

correlates with DPC at 0.271, showing some positive relationship and suggesting that strong DPC can support DSCI.

SCA and export performance (EP) are positively correlated at 0.493, highlighting SCA's importance for EP. Agile supply chains can swiftly respond to market shifts, improving export sales and profitability. SCA correlates with DPC at 0.419, indicating enhanced DPC strengthens SCA, probably due to real-time data sharing and efficient coordination from digital platforms.

EP and DPC have a modest positive correlation of 0.217, implying that improved DPC may positively impact EP by indirectly promoting export growth through higher operational efficiency and innovation.

Structural Equation Modeling (SEM)

When exploring how digital supply chain integration (DSCI) affects export performance (EP), we introduce supply chain agility (SCA) as a potential intermediary. Theoretically, SCA is key for businesses to respond to market changes and enhance operational efficiency and market adaptability through digital technology. To verify SCA's intermediary role, we use a mediating model analysis with the Baron & Kenny method and the Bootstrap method to ensure the robustness of the result.

Table 4: Main Effects Analysis Results

Path	Estimate	Std_Beta	P_value	Sig
SCA ← DSCI	0.539	0.554	0.000	***
EP ← SCA	0.736	0.738	0.000	***
EP ← DSCI	-0.398	-0.410	0.000	***
ab	0.397	0.409	0.000	***
total	0.000	0.000	0.992	

Table 4 presents the analysis results of the mediation model where DSCI is the independent variable, EP is the dependent variable, and SCA is the mediator. The data shows a significant impact of DSCI on SCA, with a path coefficient of 0.539, a standardized coefficient of 0.554, and a P-value of 0.000, indicating that enhanced DSCI significantly strengthens SCA. SCA also significantly affects EP, with a path coefficient of 0.736, a standardized coefficient of 0.738, and a P-value of 0.000, showing that improved SCA can significantly boost EP. Nevertheless, DSCI has a significant negative direct impact on EP, with a path coefficient of -0.398, a standardized coefficient of -0.410, and a P-value of 0.000. This might reflect short-term adverse factors during DSCI implementation that can suppress export performance. The mediation effect analysis reveals a significant indirect effect of DSCI on EP through SCA, with an indirect effect value of 0.397, a standardized indirect effect of 0.409, and a P-

value of 0.000, demonstrating SCA's crucial mediating role between DSCI and EP. The total impact is 0.000 with a P-value of 0.992, which is insignificant. This is mainly due to offsetting DSCI's positive indirect and adverse direct effects on EP. We have drawn a path diagram of the mediation model to understand the above mediation's impact better. See Figure 2.

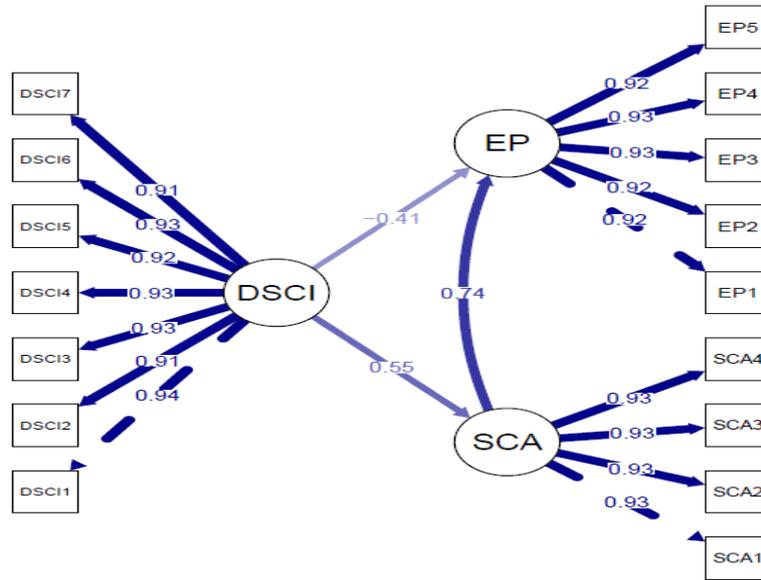


Figure 2: Path Diagram

Our analysis also focuses on the moderating role of digital procurement capability (DPC) in the relationship between DSCI and SCA. DPC measures the digitization level of procurement processes and is expected to enhance DSCI's positive impact on SCA. We performed a simple slopes analysis with grouped regression to test this hypothesis, assessing DSCI's effect on SCA at different DPC levels.

Table 5: Simple Slopes Analysis

DPC_c Level	Estimate	Std. Error	t value	p-value
-1SD	0.437***	0.044	9.861	<0.001
Mean	0.474***	0.033	14.357	<0.001
+1SD	0.510***	0.044	11.547	<0.001

Table 5 presents the results, showing significant simple slopes across all DPC levels. At -1SD, mean, and +1SD of DPC, the impact of DSCI on SCA is significantly positive ($p < 0.001$), indicating DSCI always positively predicts SCA regardless of DPC levels. However, the slope magnitude increases from 0.437 at -1SD to 0.474 at the mean and 0.510 at +1SD, demonstrating that higher DPC strengthens DSCI's positive effect on SCA. Thus, DPC positively moderates the DSCI-SCA relationship.

Figure 3 visually illustrates these simple slopes, offering an intuitive understanding of how DPC's moderating effect operates in practice.

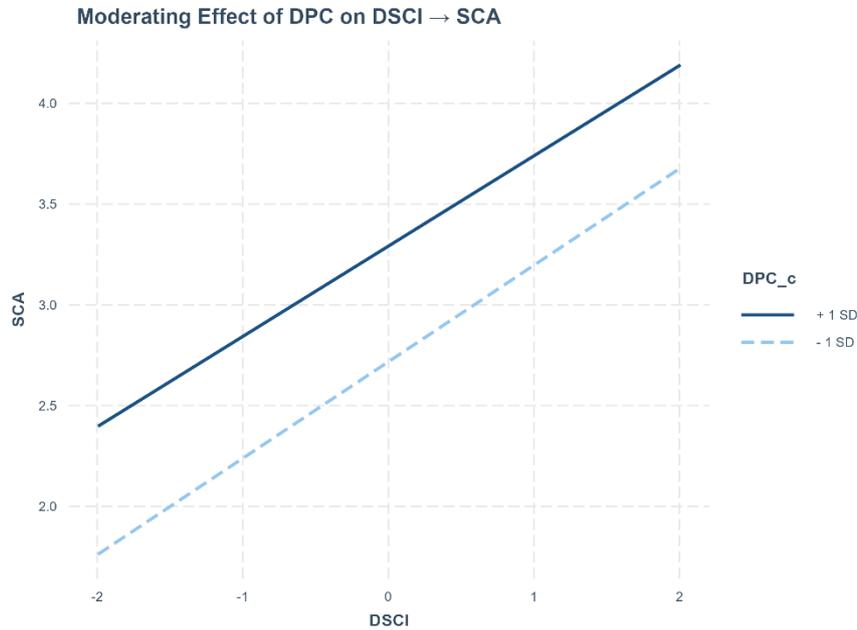


Figure 3: Moderating Effect of DPC on DSCI to SCA

Discussion

This study explores the complex relationships among Digital Supply Chain Integration (DSCI), Supply Chain Agility (SCA), Digital Platform Capability (DPC), and Export Performance (EP). It finds that DSCI significantly enhances SCA by optimizing supply chain processes and improving market responsiveness through digital technologies. SCA positively impacts EP, highlighting its critical role in export success. While DSCI negatively impacts EP, it indirectly enhances EP through SCA's mediating role. DPC significantly moderates the relationship between DSCI and SCA, with robust digital platforms strengthening this relationship. Background variables like firm size, export experience, and logistics infrastructure also play unique roles: larger firms excel in digital transformation and supply chain management; firms with rich export experience show higher supply chain agility; and strong logistics infrastructure is vital for enhancing SCA and EP.

Conclusion

This study reveals the complex relationships among Digital Supply Chain Integration (DSCI), Supply Chain Agility (SCA), Digital Platform Capability (DPC), and Export Performance (EP). DSCI significantly enhances SCA but has no direct significant impact on EP, which may be negative in the

short term. SCA positively affects EP and mediates the relationship between DSCI and EP. DPC significantly moderates the DSCI-SCA relationship. Larger firms with rich export experience and robust logistics infrastructure hold advantages. The findings offer theoretical and practical insights for e-commerce firms to optimize supply chain management and boost export performance.

Limitations

Despite the contributions of this study, several limitations should be acknowledged. Using cross-sectional data limits the ability to infer causality and track changes over time. Future research would benefit from longitudinal studies to capture the evolving nature of these relationships. Additionally, the focus on a single industry in a specific region may restrict the generalizability of the findings. Future research should explore these dynamics across different sectors and areas to enhance the robustness of the conclusions. While significant, the negative impact of market orientation on dynamic capability requires further investigation to understand the underlying mechanisms and contextual factors at play. The minor indirect effects suggest that other mediating or moderating factors may influence the relationship between market orientation, IT capability, and competitive performance.

Future Research Directions

1. Expand Research Scope: Future studies should include e-commerce firms from various countries and industries to enable cross-cultural and cross-industry comparisons. This will enhance the generalizability of findings regarding digital supply chain management.

2. Explore Emerging Technologies: Investigate the applications of emerging technologies like blockchain, IoT, and big data analytics in supply chain management. Focus on how these technologies enhance supply chain transparency, traceability, and predictive capabilities.

3. Incorporate Additional Variables: Introduce more variables such as firm innovation capacity, organizational culture, and leadership styles. This will help build more complex models to analyze the factors affecting export performance.

4. Adopt Longitudinal Research Designs: Use longitudinal studies to track the digital transformation of e-commerce firms over time. This approach will provide insights into the long-term impacts of digital supply chain integration and agility on export performance.

5. Integrate Qualitative Research Methods: Combine qualitative methods such as in-depth interviews and case studies with quantitative approaches. This will offer richer practical insights into the challenges and experiences of firms undergoing digital transformation.

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