The Impact of Corporate Digital Transformation on Supply Chain Resilience from the Perspective of Absorptive Capacity

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Abstract. Improving supply chain resilience is now a key approach for companies aiming to achieve high-quality growth and construct a contemporary industrial framework. Utilizing data from Chinese A-share listed companies spanning 2014 to 2023, this study empirically investigates the impact of corporate digital transformation on supply chain resilience, with a specific focus on the mediating role of absorptive capacity. The findings reveal that corporate digital transformation significantly enhances supply chain resilience, with absorptive capacity acting as a mediator. Heterogeneity analysis indicates that the benefits of digital transformation manifest unevenly across regions, with the effect on supply chain resilience being particularly evident in the eastern provinces. This study not only enriches the existing literature on supply chain resilience but also provides theoretical support and empirical evidence for enterprises to optimize their digital strategy planning and for governments to implement differentiated policies to enhance supply chain resilience and security.

Keywords: Corporate digital transformation; Supply chain resilience; Dynamic capabilities

1 Introduction

The global competitive landscape is being reshaped by a new round of technological and industrial change, making the accelerated integration of the digital and real economies an essential strategy for enterprises worldwide to survive and achieve high-quality development. In May 2025, the Ministry of Commerce and seven other departments jointly issued the “Special Action Plan for Accelerating Digital and Intelligent Supply Chain Development,” which stipulates that by 2030, a digital and intelligent supply chain system that is deeply embedded, smart and efficient, and autonomous and controllable will be basically established in key industries and critical sectors.The "15th Five-Year Plan" proposal states: "Enhance the level of autonomy and controllability of industrial chains, strengthen the restructuring of industrial foundations and the development of major technological equipment," and " Steer the logical and well-sequenced cross-border arrangement of industrial and supply chains." Against this backdrop of current policies, conducting in-depth research on the impact of the current digital trans-

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formation on supply chain resilience is not only an imperative for enterprises adapting to the digital age, but also a strategic decision concerning national economic security.

2 Theoretical Analysis and Research Hypotheses

2.1 Corporate Digital Transformation and Supply Chain Resilience

The notion of supply chain resilience captures how effectively a supply chain can resist, adapt to, and rapidly recover its original or intended state after unexpected shocks.[1] . Traditional supply chain management often focuses on cost minimization and lean production; however, this centralized management model is highly susceptible to the "bullwhip effect" caused by single points of failure in dynamic risk scenarios, leading to supply chain disruptions and severe economic losses[2] .In contrast, while a diversified supply chain configuration can mitigate risks, its effectiveness depends on information transparency and coordination efficiency across all links. Digital transformation enables enterprises to share supply chain information and knowledge more easily, breaking down the silos of information between supply chain participants. This allows enterprises to quickly understand market supply and demand dynamics, as well as data from all links in the supply chain[3]. For one thing, information sharing enables suppliers to accurately grasp changes in customer demand, improving the precision of supply-demand resource matching and the coordination efficiency between upstream and downstream enterprises. For another, screening potential customers or suppliers on a broader scale can reduce a company's reliance on any single customer or supplier, promote supply chain diversification, and allow the company to flexibly adjust supplier, channel, and inventory strategies when facing shocks[4] .Furthermore, excessively high transaction costs limit a company's willingness and ability to maintain supply chains and acquire new customers[4] . However, the increased supply chain transparency and information sharing resulting from digital transformation help reduce costs arising from information asymmetry and negotiation, creating more favorable cost conditions for companies to expand their supply chain networks.

Accordingly, the following hypothesis is put forward in this paper:

H1: Supply chains can be made much more resilient by corporate digital transformation.

2.2 Corporate Digital Transformation, Absorptive Capacity, and Supply Chain Resilience

Absorptive capacity describes how well a company can identify, absorb and internalize, and ultimately apply external information and knowledge[5]. In the development of resilient supply chains, absorptive capacity facilitates efficient integration of information resources for enterprises, allowing them to identify structural vulnerabilities and prospective risks, curtail disruption-triggered losses, and ultimately boost the supply chain's defensive capacity[6] . However, this requires companies to possess strong environmental scanning capabilities in order to obtain external information in a timely manner. Digital transformation, through IoT and blockchain, helps enterprises develop faster and more robust identification capabilities to search for and internalize valuable information. The adoption of digital technologies not only provides information-sharing channels and platforms for enterprises at various supply chain nodes but also fosters closer connections among them, promoting the formation of a symbiotic and mutually supportive supply chain ecosystem, thereby enhancing the overall supply chain resilience [7][8] . Concurrently, promoting digital transformation in enterprises can help companies within the supply chain identify internal information—such as product production and sales processes—as well as external knowledge—such as market dynamics and consumer preferences—at lower costs and with higher efficiency. This significantly reduces various costs associated with information search and processing, as well as transaction costs related to supply-demand matching[9] .

The following hypothesis is proposed by this paper, as demonstrated in the above analysis:

H2: Digital transformation can greatly improve a corporate ability to absorb new technologies, which in turn can boost resilience of the supply chain.

3 Research Design

3.1 Model Specification

For the purpose of analysing the impact of corporate digital transformation on supply chain resilience, the following baseline regression model has been constructed:

$$Resil_{it} = \beta_0 + \beta_1 DIGI_{it} + \sum \gamma Controls_{it} + \sum Firm + \sum Year + \varepsilon_{it} \quad (1)$$

where $Resil_{it}$ represents the dependent variable, supply chain resilience; $DIGI_{it}$ represents the key independent variable, the degree of corporate digital transformation; $Controls_{it}$ is a set of control variables; $Firm$ and $Year$ are firm and year fixed effects; and ε_{it} is the random error term.

3.2 Variable Definitions

Dependent Variable: Supply Chain Resilience. Golgeci and Kuivalainen argue that resistance and recovery capacity are key factors in building supply chain resilience[10] . Consequently, following the approach of Zhang Shushan et al.[4], this study develops an indicator system grounded in two dimensions—supply chain resistance and recovery capacity—and employs the entropy technique to compute the supply chain resilience index. This study uses two proxies for supply chain resilience: the natural logarithm of the accounts receivable-to-sales ratio, and the proportion of non-new customers among a firm's top five major customers (i.e., the number of non-new top-five customers divided by 5). Recovery capacity is measured using inventory turnover and the economic performance sensitivity index. The formula for this index is as follows:

$$SI_{it} = (lnx_{it} - lnx_{it-1}) - (lnX_{it} - lnX_{it-1}) \quad (2)$$

Here, x_{it} represents the main business revenue of firm i in year t, and X_{it} represents the total operating revenue of the industry in which firm i operates in year t. If SI is greater than 0, it indicates that firm i's performance is growing faster than that of the industry, and thus its resilience is stronger.

Core explanatory variable: Corporate Digital Transformation. Drawing on the research by Zhao Chenyu[11] , this paper employs text analysis to construct a corporate digital transformation index.First, text data from the business performance analysis sections of the sample companies' annual reports was extracted using Python. Second, a keyword dictionary focusing on digital transformation was created based on four core dimensions: digital technology applications, internet business models, smart manufacturing and modern information systems. Third, the Jieba tokenization tool was used to process the entire text, and the frequency of keyword disclosures across each dimension was calculated. Finally, the word frequency data was standardized, and the DIGI index was synthesized using an entropy-weighted method.

Moderating Variable: Absorptive Capacity (Abs). Absorptive capacity helps firms internalize external information or technology and integrate it with their own knowledge and technology to drive innovation. At the same time, high levels of internal R&D effort enhance a firm's ability to internalize external technological knowledge and apply it to its own business objectives, thereby improving the efficiency of external technology adoption. Therefore, a firm's R&D efforts are a key indicator of its absorptive capacity. This study measures this variable using the ratio of R&D expenditure to operating revenue.

Control Variables: To control for all factors affecting supply chain resilience, this study draws on previous research[3][4][11] and selects the following control variables: Size, Lev, Mfee, Top1, Listage, INST, and Cash.

3.3 Data Description

Table 1. Descriptive Statistics of Variables.

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Median	Maximum
Resil	34007	0.360	0.352	0.007	0.172	0.980
DIGI	34007	0.020	0.025	0.000	0.007	0.361
Abs	34007	0.030	0.053	0.000	0.015	0.497
Size	34007	22.270	1.294	19.470	22.073	26.456
Lev	34007	0.410	0.203	0.053	0.401	0.907
Mfee	34007	0.090	0.073	0.000	0.067	0.766
Top 1	34007	0.330	0.147	0.084	0.310	0.745
Listage	34007	2.080	0.942	0.000	2.197	3.434
Inst	34007	0.420	0.244	0.000	0.428	0.920
Cash	34007	0.050	0.067	-0.195	0.045	0.266

Considering data accessibility constraints, this study selects Chinese A-share listed manufacturing firms over the period 2014–2023 as its research sample. The data come from the CSMAR database, and corporate annual reports are sourced from the Juchao Information Network. To meet research requirements, The raw data were processed as follows: ① Removal of ST, *ST, delisted, and financial industry firms over the sample window;② We deleted observations where key variables had severe missing values; ③ Major continuous variables were trimmed at the 1% two-sided threshold. The descriptive statistics shown in Table 1 center on the primary research variables.

4 Empirical Results and Analysis

4.1 Baseline Regression

The outcomes of the baseline regression examining how corporate digital transformation affects supply chain resilience are displayed in Table 2. In Column (1), only firm and year fixed effects are controlled for, whereas Column (2) incorporates additional control variables on top of those in Column (1). All estimated DIGI coefficients are found to be significantly positive at the 1% level. This shows that corporate digital transformation can significantly enhance supply chain resilience, thereby validating Hypothesis H1.

Table 2. Baseline Regression Results.

Variables	(1) Resil	(2) Resil
DIGI	0.950***	0.508***
	(5.22)	(2.73)
Control variable	NO	YES
Firm/Year Fixed Effects	YES	YES
N	34007	34007
R^2	0.612	0.636

4.2 Endogeneity Treatment

Instrumental Variables Method. To mitigate endogeneity issues in the model caused by reverse causality, the analysis employs the mean digital transformation level of peer firms in the same industry and year (IV1) as an instrumental variable, which is estimated through 2SLS. Other firms in the same industry and year face similar technological environments, competitive pressures, and policy orientations; however, their level of digital transformation does not directly affect the supply chain resilience indicators of the firm under study, thereby meeting the requirements for exogeneity and correlation in instrumental variable selection. Table 3 shows the results of the instrumental variable regression analysis. Column (1) reports the first-stage regression results, where the coefficient on IV1 is positive and statistically significant at the 1% level. The correlation condition is thus satisfied. As shown in Column (2), the second-stage DIGI coefficient is significantly positive at the 5% level. This is consistent with the conclusions of the baseline regression.

Heckman two-stage regression. To mitigate endogeneity issues potentially caused by sample self-selection bias in the model, this research further applies the Heckman two-stage model for testing. The first stage of this study uses the industry-year mean of digital transformation for peer firms (IV1) as the exclusionary constraint variable. A Probit regression is conducted using the firm's digital transformation status (DIGI_dum), IV1, and control variables, and IMR is calculated. In the second stage, the IMR is incorporated into the baseline regression model in order to correct for selection bias. Table 3 reports the results of the Heckman two-stage test. Column (3) reports that all IV1 coefficients are positive and significant at the 1% level. Column (4) shows that, after including the inverse Mills ratio, the DIGI coefficient remains significantly positive at the 1% level, indicating that the results are robust.

4.3 Robustness Tests

This paper employs the following two methods for robustness testing: ① To eliminate the effects of differences in clustering levels, this study changes the clustering level from firm-level to two-way clustering by year and industry. As shown in column (5) of Table 3, the coefficient of DIGI remains significantly positive, suggesting that potential interference from different levels of standard error clustering can be excluded from the baseline regression. ② To address the potential impact of selection bias relating to the level of digital transformation of firms on the statistical results, this study uses PSM method to test robustness. Specifically, using the annual industry-level average of digital transformation scores as the threshold, firms were categorized into high- and low-transformation groups. Concurrently, the control variables discussed above were used as matching covariates and the sample was matched using the 1:1 nearest-neighbour matching method. The results of the matched regression are shown in Column (6) of Table 3; the regression coefficient for DIGI is positive at the 5% significance level, implying that the study's conclusions hold up.

Table 3. Endogeneity Treatment and Robustness Test Results.

	Endogeneity Treatment				Robustness Tests	
	Instrumental Variables Method		Heckman		Double Clustering	PSM
	(1)	(2)	(3)	(4)	(5)	(6)
	DIGI	Resil	DIGI_dum	Resil	Resil	Resil
DIGI		1.404^{**}		0.5295^{***}	0.508^{***}	0.497^{**}
		(0.600)		(2.8312)	(3.04)	(2.530)
IV1	0.585^{***}		58.5105^{***}			
	(0.036)		(55.9495)			
Imr				-0.0044		
				(-1.3517)		
Control variable	YES	YES	YES	YES	YES	YES
Firm/Year Fixed Effects	YES	YES	YES	YES	YES	YES
N	33427	33427	33428	33427	34007	15839
R^2		0.056		0.6397	0.636	0.693
Kleibergen-Park	246.677					
LM statistic	[0.000]					
Kleibergen-Park	261.979					
Wald F-statistic	[16.380]					

4.4 Testing for Mediation Effects

To examine if absorptive capacity serves as a channel through which corporate digital transformation influences supply chain resilience, this study will employ a "two-step approach" and the Sobel test to test for mediation and construct the following model:

$$Abs_{it} = \beta_0 + \beta_1 \mathrm{DIGI}_{it} + \sum\gamma Controls_{it} + \sum Firm + \sum Year + \varepsilon_{it} \tag{3}$$

Here, Abs_{it} represents the mediating variable's absorption capacity. The mediation analysis for absorptive capacity is presented in Column (1) of Table 4, and the regression results indicate a positive effect significant at the 1% level. Furthermore, the Sobel test yielded a Z-value of 19.03 and a p-value of less than 0.01, further confirming the existence of a mediation effect and supporting Hypothesis H2.

4.5 Heterogeneity Test

Analysis of heterogeneity in market competition intensity. With the HHI of operating revenue for listed companies in each industry serving as the measurement, the data was divided into two subsamples—one for industries with strong competition and another for industries with weak competition—based on the mean HHI, and regression tests were conducted separately for each. As shown in columns (2) and (3) of Table 4, digital transformation exerts a significantly positive impact on supply chain resilience in highly competitive industries, while its effect is insignificant in less competitive industries. Companies operating in highly competitive industries tend to more actively pursue digital transformation to build agile and stable supply chain systems in order to maintain their market position and secure a strategic edge.

Table 4. Results of Mediating Effects and Heterogeneity Analysis.

	Mediating Effects	Heterogeneity Analysis			
	(1)	(2)	(3)	(4)	(5)
	Abs	Strong market competition	Weak market competition	High-tech industry	Non-high-tech industries
DIGI	0.287***	0.504**	0.356	0.428**	0.376
	(6.93)	(2.20)	(1.02)	(2.04)	(0.95)
Control variables	YES	YES	YES	YES	YES
Firm/Year Fixed Effects	YES	YES	YES	YES	YES
Sobel Z-value	19.03				
Observed value	34007	21,725	11,623	19,106	14,768
R^2	0.808	0.660	0.668	0.634	0.653

Analysis of Industry Characteristic Heterogeneity. This study follows the China Securities Regulatory Commission's "Guidelines for the Classification of Listed Companies by Industry" (revised in 2012). It classifies companies with industry codes C26, C27, C28, C34, C35, C36, C37, C38, C39, C40, I63, I64, I65, M73, and M74 during the sample period as one group, while enterprises in all other industries are defined as non-high-tech enterprises. Columns (4) and (5) of Table 4 indicate that while digital transformation significantly bolsters supply chain resilience for high-tech enterprises, this effect is negligible for their non-high-tech counterparts. This disparity likely stems from the fact that high-tech firms exhibit a more intensive reliance on digital technologies. Their digital transformation can be deeply embedded in core processes such as product R&D and production coordination. Through technology spillovers and knowledge sharing, they empower upstream and downstream enterprises in the supply chain, optimizing supply chain coordination efficiency and stability, thereby effectively enhancing resilience.

5 Conclusions and Recommendations

Using panel data on A-share listed companies spanning 2014 to 2023, this paper investigates the relationship between digital transformation and supply chain resilience, focusing specifically on identifying the transmission channels involved.The findings are as follows: ① Digital transformation in listed companies can greatly improve supply chain resilience; ② Digital transformation enhances supply chain resilience by channeling its effects through absorptive capacity; ③ Heterogeneity analysis indicates that the positive effect of digital transformation on supply chain resilience is significantly stronger in highly competitive markets and, particularly, within high-tech sectors. Drawing on these findings, this paper proposes the following policy implications:

Firstly, corporate digital transformation should continue, with a focus on integrating digital technologies into supply chains. Firms should build digital platforms covering R&D, procurement, production, logistics, and sales to break data barriers and coordinate information, capital, and material flows efficiently. Big data analytics and artificial intelligence can improve supply-demand matching and supply chain transparency, thereby strengthening risk perception and response. Governments should use fiscal subsidies, tax incentives, and special funds to help SMEs overcome the challenges of "not knowing how to transform" and "fearing transformation," while providing technical guidance and talent training.

Secondly, efforts should cultivate enterprises' technological absorption capacity. Firms should increase R&D investment, recruit high-calibre technical talent, and establish open learning mechanisms to better identify and internalise advanced technologies, market information, and supply chain risks. Collaboration with suppliers, customers, and research institutions should be strengthened to integrate internal and external knowledge, enhancing the effectiveness of external technology application. Governments may encourage such investment through industry-academia-research cooperation initiatives and R&D tax deductions, creating an institutional environment that fosters absorption capacity.

Thirdly, differentiated policies should be implemented. In industries with intense market competition, enterprises should be encouraged to use digital transformation to build agile and stable supply chains for a competitive edge; in less competitive industries, policy guidance is needed to stimulate transformation motivation. For high-tech industries, extensive integration of digital technologies with core processes such as R&D and production should be strengthened to leverage technological spillovers; for non-high-tech industries, they should be encouraged to draw on successful experiences of high-tech sectors to promote digital technology application in traditional manufacturing and services, thereby fortifying the resilience of the entire industry's supply chains.

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