

The Impact of Corporate Digital Transformation on Supply Chain Management: The Mediating Role of Corporate Innovativeness and Risk Resilience

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Abstract: Supply chain management is one of the core aspects of an enterprise's integrated business processes. Based on the realistic needs of enterprises to optimise their supply chain management, this paper collects data from a sample of domestic listed enterprises' annual reports disclosed from 2007 to 2019 to empirically investigate the impact of digital transformation on supply chain management. It is tested that digital transformation can significantly optimise the supply chain management of enterprises, and this optimisation effect is heterogeneous according to the asset structure characteristics and industry technology attributes of enterprises. The analysis of the mechanism found that digital transformation helps companies achieve higher levels of innovation, while strengthening their risk resilience and thus achieving spillover benefits to supply chain management. In view of this, this paper suggests deepening the construction of enterprise digital ecology, enriching enterprise digital industry support, and further creating a good supply chain operation system for enterprises.

Keywords: Digital transformation, Supply chain management, Innovation capability, Risk resilience.

1. Introduction

From a macro level, supply chain management is an important part of the management of social and economic factors, and from a micro level, supply chain management is a necessary step for enterprises to unblock their own production and sales and boost their operational efficiency. The report of the 19th National Congress forward-lookingly pointed out that "new growth points and new dynamics will be fostered in modern supply chains and other areas", clearly placing supply chain management in a prominent position in economic development. In the current era of rapid growth of the digital economy, the deep integration of digital technology and enterprise supply chain management is already a major trend, and the empowerment of data elements can help enterprises cope with the cumbersome processes between different supply chain nodes, improve the level of supply chain linkage and shorten interaction response time. However, it is worth pointing out that the relationship between "digital transformation" and "supply chain management" has not been clarified in academic literature, and there are still some differences in the theoretical logic between the two. In view of this, this study aims to explore the impact of "digital transformation - supply chain management" with the help of data metrics, and further identify and test the channel mechanism between them, which has practical implications for optimising enterprise supply chain management and clarifying the link between digital transformation and supply chain management.

2. Literature Review

In recent years, with the exploration of the government, industry and academia to improve the quality and efficiency of micro-economy, optimising supply chain management has become an important breakthrough for enterprises to consolidate their capital and increase revenue. The academic research on the impact factors of supply chain management

of enterprises is more from logistics level, information transparency level, regional governance level and other dimensions, but there are few literature exploring supply chain management based on the perspective of the overall technology level of enterprises. The research on the impact of digital transformation is more focused on the short-term output such as operational efficiency, financial profitability and technological innovation, and there is also some exploration on the impact of digital transformation on the long-term management activities of enterprises. However, there is not yet a rich theoretical system associated with the supply chain ecology at the micro-management level. Then, in supply chain management, which plans, coordinates and controls the logistics, information and capital flows among the participating organisations and departments in the whole supply chain [1], the digital transformation of enterprises can achieve a high degree of resource sharing and collaboration by effectively managing the digital workflow, information flow and logistics within and outside the enterprise, transforming and upgrading the traditional industrial chain supply chain, accelerating business optimisation and restructuring, and innovation and upgrading [2] so as to achieve the improvement of supply chain management. At the same time, digital transformation, as an important innovation tool for the overall improvement of enterprise efficiency, can combine with the supply chain management needs of enterprise development and form a targeted promotion effect.

Digital transformation helps to stimulate innovation and improve supply chain management. In essence, digital transformation is the in-depth application of existing digital technologies to the business dynamics of enterprises. Compared to non-technical innovations, digital transformation "directly touches" science and technology as a source of productivity, and can regulate the contradiction of resource integration in technological innovation, forming an efficient resource structure for scientific and technological innovation [3]. Therefore, when the digital transformation creates better conditions for innovation, the technology

patents, model optimisation solutions and institutional design formed in the process of innovation will also improve the operational efficiency of the enterprise from the management level, on the one hand, the spillover effect of this influence provides better prerequisites for the optimisation of supply chain management; on the other hand, this influence will also ideologically motivate On the other hand, this impact will also ideologically motivate the supply chain management to experiment and break through the bottlenecks that existed at the supply chain management level.

The digital transformation of enterprises helps to improve their risk resilience and thus "protects" them from optimising their supply chain management. As the digital transformation process progresses, the technological advantages of data empowerment can help companies better understand their business management shackles and reshape their management structures and internal control systems. In particular, at the management level, digital transformation can improve the control of internal information by shareholders and management from the dimension of information governance[4] and reduce internal and external information uncertainty, thus enhancing the ability of enterprises to manage risks in advance. In addition, with the upgrading of the enterprise management model and the improvement of the enterprise's revenue generation level, the enterprise's risk resilience will also be strengthened. On the other hand, the increased risk resilience of enterprises also means that their

supply chain management will have greater flexibility to operate, so that they can flexibly make adjustments to their supply chain management based on the real needs of the market business, thus making supply chain management move in response to the situation and achieving higher management efficiency. Based on the above analysis, the research hypothesis of this paper is proposed:

Hypothesis: The digital transformation of enterprises has a catalytic effect on supply chain management, provided that other conditions remain unchanged.

3. Data and Methodology

3.1. Sample selection and data sources

In this paper, China's A-share listed enterprises are included in the study sample and the period 2007-2019 is selected as the time interval to construct the panel data, while the underlying data are collated based on the following operations: firstly, the delisting and IPO inspection period samples such as ST, SP are excluded; secondly, sensitive industries such as finance and real estate are excluded; thirdly, individual enterprises with missing key data are excluded; fourthly, the data are Fourth, the data were Winsorize (1%) processed using STATA.

3.2. Variable setting

Table 1. Variable definitions

Variable type	Variable name and symbol	Variable definition method
Explanatory variable	Digital Transformation (DCG)	$\ln(1 + \text{total number of digitally transformed texts})$
Explained variable	Supply Chain Management (SCM)	Inventory turnover
Control Variables (CVs)	Leverage ratio (LEV)	Total liabilities/total assets
	Return on Net Assets (ROE)	Purified Profit / Total Equity
	Business Size(Scale)	$\ln \text{ Total Assets}$
	Age of establishment(Age)	Year of reporting period - Year of establishment
	Shareholding dispersion (LSR)	Percentage of shareholding of the largest shareholder
	Nature of ownership (State)	1 for SOE, 0 for vice versa

3.3. Empirical model design

This paper uses an OLS panel regression model to carry out the empirical study, with two-way fixed effects selected based on endogeneity to deal with demand; in addition, to achieve the identification of the intermediation channel mechanism, this paper draws on the approach of Wen Zhonglin (2004)[5]. In summary, the econometric model employed in this paper is shown below.

3.3.1. Baseline regression model

$$SCM_{i,t} = \theta + \theta_1 DCG_{i,t} + \sum \varphi CVs + \sum Year + \sum Industry + w \quad (1)$$

3.3.2. Intermediary effects model

$$SCM_{i,t} = \theta + \theta_1 DCG_{i,t} + \sum \varphi CVs + \sum Year + \sum Industry + w \quad (2)$$

$$Mediator_{i,t} = \delta + \delta_1 DCG_{i,t} + \sum \varphi CVs + \sum Year + \sum Industry + w \quad (3)$$

$$SCM_{i,t} = \phi + \phi_1 Mediator_{i,t} + \phi_2 DCG_{i,t} + \sum \varphi CVs + \sum Year + \sum Industry + w \quad (4)$$

4. Results and Analysis

4.1. Descriptive statistics analysis

Table 2 below reports the results of the descriptive statistics for the main model variables. The overall observed sample size is 19,679, with the core explanatory variable supply chain management (SCM) having a mean value of 8.869 and a standard deviation of 18.172, indicating a large variation in supply chain management among the sample firms. Similarly, the mean (1.231) and standard deviation (1.429) of digital transformation (DCG) also reflect the wide gap in digitalisation levels between the sample companies, with some companies still relatively slow in their digital processes.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
SCM	19679	8.869	18.172	0.138	110.322
DCG	19679	1.231	1.429	0	6.397
LEV	19679	0.439	0.200	0.051	0.861
ROE	19679	0.070	0.089	-0.369	0.311
Scale	19679	22.091	1.312	14.158	28.509
Age	19679	2.764	0.371	1.609	3.434
LSR	19679	34.751	14.829	8.940	74.300
State	19679	0.446	0.497	0	1

4.2. Baseline regression

Table 3 reports the results of the full-sample regression of "Digital Transformation - Supply Chain Management", with model (1) to model (3) including two-way fixed effects and control variables in that order. The regression results show

that the regression coefficients of SCM on digital transformation (DCG) are positive regardless of whether two-way fixed effects and control variables are included, indicating that supply chain management can be effectively optimised as companies become more digital.

Table 3. Baseline regression analysis

	(1) SCM	(2) SCM	(3) SCM
DCG	0.810*** (7.26)	0.435*** (3.29)	0.469*** (3.50)
LEV			-3.931*** (-4.67)
ROE			6.296*** (4.18)
Scale			-0.265** (-1.96)
Age			2.014*** (4.90)
LSR			0.039*** (4.23)
State			-0.559** (-2.06)
_cons	7.861*** (48.46)	9.446*** (7.28)	19.354*** (4.43)
Ind、Year	No	Yes	Yes
N	19679	19679	19679
r2	0.0040	0.2262	0.2317

Note: Cluster-adjusted t-values are in brackets. *, ** and *** indicate significant at the 10%, 5% and 1% levels respectively.

4.3. Robustness check

In order to ensure the robustness of the findings, this paper adopts digital technology adoption (DCAp)[6], a downscaled indicator, as an alternative measure of the degree of digital transformation of enterprises, while extending the observation time window. From the regression results, the coefficients of the explanatory variables are significantly positive, indicating that the findings of this paper remain unchanged after changing the statistical calibre. At the same time, the regression coefficients are positive after delaying the time window, indicating the long-term effectiveness of digital transformation in promoting supply chain management.

4.4. Heterogeneity test

The above regression analysis has concluded that there is a positive correlation between "enterprise digitalisation - supply chain management", however, the problems faced by supply chain management in different types of enterprises and the difficulty of optimising and improving it may differ, especially in terms of the enterprise's asset. Therefore, this paper constructs data samples from two perspectives, namely

asset structure and industry technology attributes, and groups companies into categories.

The heterogeneity test shows that the regression coefficients of the asset-light operation group are significantly larger than those of the asset-heavy operation group, indicating that the optimization effect of digital transformation on supply chain management is relatively weaker for the asset-heavy operation enterprises.

4.5. Identification of transmission paths

In terms of identifying the transmission path, this paper argues that there are two main dimensions of the impact path of digital transformation on supply chain management. Therefore, two sets of mediating variables are selected to test whether this transmission path is valid, the first one is the level of innovation (Pat_Inv, the number of R&D patents is taken as logarithm)[7] and the second one is the risk resistance (Risk_Abi)[8].

From the regression results, the coefficients of the mediating variables in the recursive equation are all positive and pass the Sobel mechanism test, indicating that firstly, the digital transformation of enterprises helps enterprises to form

more innovations, and with the increase of innovations, the spillover effect formed by the innovations will also act on the supply management of enterprises, thus improving the supply chain management of enterprises; secondly, the digital transformation of enterprises from production Secondly, the digital transformation of enterprises brings revolutionary changes to enterprises from production, operation and other aspects, which is conducive to the formation of higher resilience to risks, thus prompting enterprises to actively layout supply chain management and improve their own supply chain management when they have the capacity to do so.

5. Conclusion

This paper examines the impact of digital transformation on supply chains, exploring the heterogeneous characteristics of technology attributes across capital structures and industries, and using mediating effects tests to unlock the "black box" of the mechanisms involved, with the following main findings: Firstly, digital transformation has a positive driving effect on supply chain management, and after multi-dimensional Firstly, digital transformation has a positive effect on supply chain management, and this finding remains unchanged after a multi-dimensional robustness test. Second, digital transformation has a relatively low effect on supply chain gains for firms operating in asset-heavy and high-tech industries. Thirdly, the digital transformation of enterprises can contribute to the rise of supply chain management through two channel mechanisms, namely innovation boosting and risk resistance strengthening. Therefore, this paper argues that in order to further deepen the ecological development of supply chain and form a long-term mechanism for economic growth, the digital transformation of enterprises should be deepened, especially for enterprises that urgently need to improve their supply chain conditions, digital technology enterprises should be further guided to

develop more digital application technologies related to supply chain, and thus provide a richer digital technology package for supply chain management, so as to channel This will facilitate the transmission channel of "digital transformation of enterprises - supply chain management" and promote the digital transformation of enterprises to form more efficient supply chain management output.

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