The Impact of Enterprise Digital Transformation on Industrial Linkages: A Case Study of Listed Companies

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Abstract. The digital economy, as an emerging economic form after agriculture and industrial economy, is playing an increasingly important role in social development. Its goal is to achieve industrial automation, which is an important step in the digital power strategy. Based on this, this paper studies the impact of enterprise Digital transformation on industrial chain linkages, and analyzes the impact of enterprise Digital transformation on industrial chain linkages. The results show that: (1) Digital transformation of enterprises promotes the linkage of industrial chains; (2) Enterprise innovation plays an intermediary role in the impact of enterprise Digital transformation on industrial chain linkage; (3) The impact of enterprise Digital transformation on industrial chain linkage varies in different regions and industries. This paper discusses the Digital transformation of enterprises and its economic consequences, providing a theoretical basis for Digital transformation of enterprises

Keywords: Enterprise digitization; Industrial chain linkage; OLS model; enterprise innovation.

1 Introduction and Literature Review

At present, the overall speed of Digital transformation of Chinese enterprises is relatively fast, but it is still in the initial stage. At the same time, the digital awareness of enterprises is increasing, and the investment amount is also significantly increasing. Digital transformation of Chinese enterprises shows a good trend. Among them, industrial digital technology plays an important engine role in China's economic development. In the context of value chain globalization, international competition is an inevitable trend. The industrial chain, as the material foundation of the value chain and its connections, is an important place to enhance competitiveness. Enterprise Digital transformation promotes enterprise innovation, thus stimulating the emergence of more new technologies and advanced management experience, improving the communication efficiency of the industrial chain, and realizing the linkage of the industrial chain.

From the existing literature, the research on enterprise Digital transformation has been very rich. In terms of qualitative research, such as Li Hui and Liang Dandan [2020] [1] explored the path of enterprise Digital transformation. Quantitative research focuses on the measurement and economic consequences of enterprises' Digital

transformation . At the same time, it also studies the impact of the economic conse-
quences of Digital transformation on Total factor productivity from the micro level
[Zhao Chenyu et al.] [2]. At the macro level, relevant research includes stock liquidity
[Balakrishnan et al., 2014][3] and industry chain correlation [Zhang Hu et al., 2023][4],
with a focus on analyzing the impact of enterprise digitization on industry chain linkage
from the perspective of transaction theory.

The marginal contributions of this paper are as follows:1. Based on the existing
research on the relationship between enterprise digital transformation and industrial
chain, this paper uses data of different years to explore the relationship between them;
2. In terms of relevant mechanisms, enterprise innovation as an influence path provides
a new direction of thinking; 3 In the study of heterogeneity, regional differences and
industry nature differences are studied.

2   Theoretical Mechanism and Research Hypothesis

From the perspective of enterprises themselves, according to the research results of
Zhang Hu et al. [2023] [4], the transformation of enterprises to digital enterprises ac-
celerates the process of enterprise informatization, promotes the transformation of
industrial chain mode, deepens the collaborative development of industrial chain, and
promotes the formation and development of industrial chain relations. At the same
time, the digital transformation of enterprises can help reduce the external transaction
costs of enterprises [Wu Fei et al., 2021] [5].

From the perspective of external environment, with the development of globaliza-
tion, the economy, technology and culture of various countries are continuously inte-
grated. If an enterprise wants to survive and develop, it must improve its competi-
tiveness. Enterprises should cultivate an "invisible crown" [Liu Zhibiao, 2019] [6] to
enhance their own advantages and improve their core competitiveness. Therefore, from
two aspects, the digital transformation of enterprises will promote the connection of the
industrial chain

Hypothesis **1: the digital transformation of enterprises promotes industrial
linkages.**

As an internal influencing factor of enterprise innovation, enterprise digital trans-
formation provides material and environmental basis for enterprise innovation through
the combination and optimization of soft and hard environment [Wu Fei et al., 2021].[5]
At the same time, the combination of digital technology and existing products pro-
moted the launch of new products, thus significantly improving the core technology of
enterprises, and a good innovation environment also increased the innovation benefits
of enterprises. The significant improvement of core competence is conducive to
achieving strategic alliance with other competitive enterprises, complementing each
other's advantages, and ultimately forming an inclusive, sharing and virtuous circle
innovation environment to promote the development of the industrial chain.

Hypothesis **2: Corporate Digital Transformation will promote corporate
innovation and thus promote industrial linkages.**

From the perspective of regions, enterprises directly under the central government have more resources and information advantages, and regional advantages are stronger. Secondly, enterprises in this region generally have stronger capital and management strength, lower internal control cost, and higher organizational management and operation efficiency, so they are more inclined to vertical integration development. Therefore, compared with municipalities directly under the central government, the regression results of non-municipalities are significant, and so are enterprises in the eastern region.

According to the characteristics of the industry, enterprises are divided into regulatory type and competitive type. Competitive firms have a wide range of choices and strong bargaining power, whereas regulated firms will be subject to regulation from all sides and will bear greater costs in the face of malicious default. Therefore, the external transaction costs of competitive firms are lower than those of regulated firms [Yuan Chun et al., 2021] [7], so the former is more likely to generate industrial linkages.

Hypothesis **3: firms' digital transformation can promote industrial linkages because of the differences in the regions and industries of firms.**

3   Data Sources and Measurement Models

3.1   Measurement Model Building.

This paper mainly studies the effect of enterprise digitalization on industrial chain linkage, and its benchmark regression model is as follows (cf. formula1).

$$VAS=\alpha_1+\alpha_2 Digital+\Sigma\beta_j Control+\Sigma Year+\varepsilon \qquad (1)$$

In this model, the explanatory variable is Vas, which is the Association of industry chain, the explanatory variable is Digital, which is the transformation of enterprises to Digital, and the Control variable represents the Control variable. Referring to Zhang Hu et al. [2023] [4], five Control variables were selected, including the size of enterprises, leverage, cash flow intensity, equity concentration, Yield valve.

3.2   Selection of Specific Indicators.

3.2.1 Interpreted variable and explanatory variables

Based on the model of Wu Fei et al. [2021] [5], this paper uses word frequency method to measure enterprise digital transformation. Since an enterprise's annual report records important events that happen in a year, statistical data can represent the digital transformation process of an enterprise to some extent (cf. formula2).

VAS= Amount purchased⁄(Income from main business - NET profit + Normal profits)

=Amount purchased ⁄(Income from main business - NET profit + Net worth×Average Yield valve)   (2)

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3 .2.2 Control variables

Based on the research of Wu Fei et al. [2021] [5], Yuan Chun et al. [2021] [7] and Zhang Hu et al [4]. [2023], control variables are added to the empirical model. Are respectively enterprise size, ownership concentration, asset-liability ratio, cash flow strength and return on equity.

3.3   Description of the Data Source.

Taking into account the availability and representativeness of data, extracting as much data as is available and, as a result of major trends in the digital transition beyond 2010, so this paper takes all a-share listed companies in China from 2011 to 2020 as samples and excludes St, PT and financial industry: 24,155 companies-year observation data of 3039 listed companies are obtained. All the data in this paper come from Guotai'an database.

4   Empirical Analysis

4.1   Fundamental Regression.

Column (1) was only regressive to the fixed year, and the result was positive significant at the level of 5% , and column (2) added control variables to remove the fixed effect, and the result was still positive significant at the level of 1% , (3) on the basis of adding the control variables and the fixed effect, the regression result is positive and significant at the level of 1% (cf. Table 1).

Table 1. The fundamental regression of enterprise digital transformation to industrial chain linkage

VARIABLES	(1) VAS	(2) VAS	(3) VAS
Digital	0.0152**	0.0207***	0.0322***
	(0.00604)	(0.00576)	(0.00583)
Constant	0.545***	0.337***	0.296***
	(0.00472)	(0.0249)	(0.0254)
Year	Yes	No	Yes
Control variable	Yes	Yes	Yes
Observations	24,155	24,155	24,155
R-squared	0.007	0.088	0.094

Standarderrorsinparentheses
***p<0.01,**p<0.05,*p<0.1

4.2   Mechanism testing.

The regression results (cf. Table 2) show that the impact of enterprise Digital transformation on enterprise innovation is positively significant at the level of 10% (column (1)), and the impact of enterprise innovation on industrial chain linkages is positively significant at the level of 1% (column (2)).

Table 2. Mechanism test: the impact of Enterprise Innovation

	(1)	(2)
VARIABLES	Patent	VAS
Digital	28.50*	
	(15.10)	
Patent		8.69e-06***
		(2.62e-06)
Constant	-1,021***	0.313***
	(65.32)	(0.0260)
Control variable	Yes	Yes
Year	Yes	Yes
Observations	24155	24155
R-squared	0.018	0.099

Standarderrorsinparentheses
***p<0.01,**p<0.05,*p<0.1

4.3   4.3 Heterogeneity analysis.

4 .3.1 Competitive and regulatory

According to Yuan Chun et al. [2021] [7], the industry is divided into regulatory and competitive industries. From the regression results (cf.Table 3), it can be seen that (1) the digital transformation of enterprises in regulated industries has no significant impact on the industrial chain linkage, column (2) the digital transformation of competitive industry enterprises has a positive significant impact on the industrial chain linkage at the 1% significance level.

Table 3. Heterogeneity analysis: the impact of industry characteristics

Group	(1) Regulatory	(2) Competitive
Digital	-0.0211	0.0237***
	(0.0189)	(0.00601)
Constant	0.356***	0.0660**
	(0.0490)	(0.0323)
Year	Yes	Yes
Control variable	Yes	Yes
Observations	6,176	17,979
R-squared	0.032	0.143

Standarderrorsinparentheses
***p<0.01,**p<0.05,*p<0.1

4 .3.2 Regional differences

As can be seen from the table (cf.Table 4), for enterprises located in the eastern regions and municipalities directly under the central government, the estimated coefficient of digitization transformation is not significant, while for enterprises in the central and western regions and in ordinary prefecture-level cities, the estimated coefficients of digital transformation are all significant at 1% level.

Table 4. Heterogeneity analysis: regional impact

VARIABLES	(1) Municipalities Directlyfei	(2) Non-municip alities	(3) East	(4) Middle	(5) West
Digital	0.00	0.05***	0.01	0.10***	0.09***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)
Constant	0.28***	0.30***	0.30***	0.39***	0.16**
	(0.05)	(0.03)	(0.03)	(0.06)	(0.07)
Year	Yes	Yes	Yes	Yes	Yes
Control variable	Yes	Yes	Yes	Yes	Yes
Observations	4,696	19,459	16,807	4,369	2,979
R-squared	0.099	0.094	0.100	0.092	0.116

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

4.4 Conservatism and endogeneity testing.

Based on the above analysis and referring to Zhang Hu et al. [2023] [4] [, the robustness of the model is tested by excluding central enterprises directly under the central government and marking the VAT as 0. Passed the robustness test, and the results were significant at the 1% level. At the same time, according to the practice of Guo Jiatang and Luo Pinliang [2016] [8], the endogenous test using the number of urban Internet connections as an instrumental variable has a significant effect at the level of 10%.

5 Recommendations

According to the conclusion of this paper, the following suggestions are put forward: enterprises should make full use of their own resources to carry out Digital transformation and improve their competitiveness. (1) Enterprises should learn to make full use of the dividends of Digital transformation, accelerate the incubation rate of innovative technologies, and enhance their core competitiveness. (2) For the government, the government should encourage enterprises to make Digital transformation through policies to promote the development of the digital economy. The government should attach importance to the development of regulatory industries. Strict regulatory systems may lead to industry backwardness, and appropriate digitization is more conducive to government regulation. In short, building a digital superpower requires joint efforts.

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