

Research on the impact of enterprise digital transformation on new quality productivity

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Abstract

New quality productivity is the core driving force to promote the reform of production mode and promote economic development, and how to promote the development of new quality productivity is a hot topic at present. This paper selects the data of A-share listed companies in our country from 2010 to 2022 to study the impact of digital transformation on new quality productivity, and empirically tests it. The results show that the degree of digital transformation of enterprises has a significant positive effect on promoting new quality productivity. At the mechanism level, the digital transformation of enterprises mainly promotes new quality productivity by improving green technology innovation of enterprises. The results of heterogeneity analysis show that the impact of digital transformation on new quality productivity is also different due to the different regions, property rights and scientific and technological attributes of enterprises, and there is a certain heterogeneity, and the effect of digital transformation on new quality productivity is more significant in state-owned enterprises, high-tech enterprises and enterprises in the eastern region.

Keywords

Digital transformation of enterprises; new quality productivity; Green technology innovation

1. Introduction

1.1. Measurement of the degree of digital transformation of enterprises

Digital transformation is an important driving force leading the development of various fields, and if enterprises want to follow the development trend and keep up with the pace of the changes of the times, digital transformation is inevitable. In the existing relevant research, the methods for measuring digital transformation can be mainly divided into two categories. The first category is text analysis. The two methods are represented by Wu Fei et al. [26] using the frequency of words related to digital transformation to measure, and Yuan et al. [27] using the ratio of the total

frequency of words related to enterprise digital transformation to the total number of words in "management discussion and analysis" as their quantitative indicators. The measurement accuracy of such methods is slightly rough, and the indicators constructed by text analysis methods are likely to be manipulated by the enterprise itself. The second category is measured by the proportion of intangible assets using digital transformation. The proportion of assets related to the digital economy in the intangible assets used by Zhang Yongkun et al. [28] and Qi Huaijin et al. [30] was calculated. However, from a practical point of view, digitalization-related assets include not only intangible assets but also fixed assets, so Liu Dongge et al. [11] used the sum of intangible assets and fixed assets related to digital transformation to the proportion of total assets to construct the digital transformation index of listed enterprises.

1.2. Definition of the concept of new quality productivity

GaoFan et al. [1] explained the new quality productivity in detail from multiple dimensions such as results, elements, and factor combinations. Han Yuchen et al. [4] profoundly explained the new quality productive forces proposed by General Secretary Xi Jinping based on our country's economic development in the new era, which are leapfrog productivity, innovative productivity, and green productivity. Qiao Qian et al. [8] explored the new characteristics of the components of new quality productive forces based on Marxist theory: the continuous updating of workers' skill levels, the diversification of labor objects, informatization and virtualization, and the intelligence and networking of labor materials. From the perspective of political economy, Zhou Wen and Xu Lingyun [12] believe that new quality productive forces are the productive forces led by scientific and technological innovation and the achievement of key disruptive technological breakthroughs, which are transcendence of traditional productive forces and require new production relations to adapt to them. The proposal of the new concept of new quality productive forces is the development and innovation of Marxist productive forces theory, and it is also an important theoretical proposition for the sinicization of Marxist political economy.

2. Research design

2.1. Data sources

This article uses data from A-share listed companies from 2010 to 2022. The data are mainly from the CSMAR database and the Wind database. The data are processed as follows: (1) Financial samples are excluded; (2) Eliminate samples with abnormal operations such as ST and ST*; (3) Samples with key variables as outliers or missing values are eliminated; (4) Exclude the sample of listed companies after 2011. After the above treatment, 29866 observations were obtained, and in order to avoid adverse effects on the results caused by extreme values, all variable values were indented in the range of 1%-99%.

2.2. Variable definition

2.2.1. Interpreted variables

The relevant indicators of new quality productivity are detailed in Table 1.

Table 1. Index system of new quality productivity of enterprises

Total indicators	factor	Sub-factors	index	Indicator construction instructions
New quality productivity	workforce	Living labor	Proportion of employee salaries	Employee remuneration/operating income payable
			Proportion of researchers	Number of R&D personnel/employees
			The proportion of highly educated personnel	Number of personnel/employees with bachelor's degree or above
		Materialized labor	Proportion of fixed assets	Fixed assets/total assets
			Proportion of manufacturing costs	(Subtotal cash outflow from operating activities + amortization of intangible assets + depreciation of fixed assets +.) Impairment provision - cash paid to and for employees - cash paid for goods and services paid for by employees)/ (Subtotal cash outflow from operating activities + amortization of intangible assets + depreciation of fixed assets + impairment provision)
	tools	Hard technology	Proportion of R&D expenditure	R&D expenditure/operating income
			Proportion of intangible assets	Intangible Assets/Total Assets
			Number of green invention patents authorized	Add 1 for natural logarithmic processing
		Soft technology	Proportion of fixed asset investment	Fixed assets, intangible assets and other long-term assets pay cash sum/total assets
			Total asset turnover	Operating income/total average assets
			Reciprocal of the equity multiplier	Owner's Equity/Total Assets

The relevant variables used in this paper are described in Table 2.

Table 2. Variable definitions

Variable type	Variable name	Variable symbols	Measurement methodology
Interpreted variable	New quality productivity	Npro	Calculated by entropy method
Explanatory variables	Degree of digital transformation	Dig	The sum of intangible assets and fixed assets related to digital transformation and the proportion of total assets
Mediating variables	Green technology innovation	Green	The total amount of green patent authorization plus 1 is used for natural logarithmic processing
Control variables	Asset-liability ratio	Lev	The ratio of total liabilities to total assets of the enterprise
	The shareholding ratio of the largest shareholder	top1	The ratio of the number of shares held by the largest shareholder to the total number of shares of the company
	Return on assets	LENGTH	The ratio of net profit to total assets of the enterprise
	The age at which the en-	Age	Observation year - listing year +1 and then take

	enterprise is listed		the logarithm
	Total asset growth rate	Growth	Total assets for the current year / Total assets for the previous year -1
	Enterprise size	size	Total assets are taken logarithmically
	Return on equity	ROE	Net profit / average balance of owner's equity

2.2.2. Model construction

Firstly, in order to explore the impact of the degree of digital transformation on the new quality productivity, the following model is established:

$$\text{Nopri}_{i,t} = \beta_0 + \beta_1 \text{Digi}_{i,t} + \beta_2 \text{Controls}_{i,t} + \beta_3 \text{Year}_{i,t} + \beta_4 \text{Id}_{i,t} + \varepsilon_{i,t} \quad (1)$$

In model (1), Nopr represents new quality productivity, Dig represents the degree of digital transformation of the enterprise, Control is a series of control variables, and Year and Id represent the time fixed effect and individual fixed effect, respectively. Subscripts i and t indicate the corresponding time and enterprise, respectively.

Secondly, in order to study the mechanism path of mediating variables affecting digital transformation and then new quality productivity, the following model is established:

$$\text{Nopri}_{i,t} = \beta_0 + \beta_1 \text{Digi}_{i,t} + \beta_2 \text{Controls}_{i,t} + \beta_3 \text{Year}_{i,t} + \beta_4 \text{Id}_{i,t} + \varepsilon_{i,t}$$

$$\text{Green}_{i,t} = \beta_0 + \beta_1 \text{Digi}_{i,t} + \beta_2 \text{Controls}_{i,t} + \beta_3 \text{Year}_{i,t} + \beta_4 \text{Id}_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$\text{Nopri}_{i,t} = \beta_0 + \beta_1 \text{Digi}_{i,t} + \beta_2 \text{Green}_{i,t} + \beta_3 \text{Controls}_{i,t} + \beta_4 \text{Year}_{i,t} + \beta_5 \text{Id}_{i,t} + \varepsilon_{i,t} \quad (3)$$

In the latter two models, Green is a green technology innovation, which is included in the model as an explained variable and an intermediary variable, respectively.

3. Empirical analysis

3.1. Benchmark regression analysis

Therefore, it turns out that assumption 1 is true, that is, the digital transformation of enterprises can promote the development of new quality productivity.

Table 4. Baseline regression

variable	Nopr	Nopr	Nopr	Nopr
Dig	0.005*** (0.001)	0.003*** (0.001)	0.005*** (0.001)	0.007*** (0.001)
Controls	No	Yes	No	Yes
Id	No	No	Yes	Yes
Year	No	No	Yes	Yes
Adjust the R2 value	0.004	0.126	0.649	0.660

Note: The values in parentheses are robust standard errors, and *, ** and *** indicate significant at the level of 10%, 5% and 1% respectively. The same below.

3.2. Mechanism testing

Hypothesis 2 is true.

Table 5. Mechanism test

variable	Green	Nopr
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Dig	0.170* (0.083)	0.007*** (0.001)
Green	No	Yes
Id	Yes	Yes
Year	Yes	Yes
Controls	Yes	Yes
Adjust the R2 value	0.716	0.753

3.3. Endogenous treatment

1. Instrumental variable method.

Hypothesis 1: The conclusion is solid. The detailed results are shown in Table 7.

Table 7. Endogenous test (2)

Stage1			Stage2	
variable	Dig		variable	Nopr
IV	5.453*** (0.142)		IV	0.005*** (0.001)
Controls	Yes		Controls	Yes
Year	Yes		Year	Yes
Id	Yes		Id	Yes
F-number	1466.820		Endogeneity test of endogenous regressors: P-val	0.018
Underidentification test: (P-val)	0.000			
Kleibergen-Paap rk Wald F statistic	1466.820			
10%Stock-Yogo	16.380			

3.4. Heterogeneity analysis

Table 9. Heterogeneity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
heterogeneity	Enterprise ownership		Area attributes		Scientific and technological attributes	
divide	State-owned enterprises	Non-state-owned enterprises	eastern	Midwest	High technology	Not high-tech
variable	Nopr	Nopr	Nopr	Nopr	Nopr	Nopr
Dig	0.003* (0.001)	0.009*** (0.001)	0.008*** (0.001)	0.006*** (0.006)	0.007*** (0.001)	0.005*** (0.001)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Id	Yes	Yes	Yes	Yes	Yes	Yes
Adjust the R2 value	0.701	0.692	0.738	0.635	0.665	0.738

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