



A Study of the Effect of Digital Transformation on Firm Performance —— Based on the Mediating Effect of Green Technology Innovation

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Abstract.As electronic technologies rapidly evolve, digital transformation has become an important driving force for high-quality development of firms. In this context, studying the impact of digital transformation on firm performance is of great theoretical and practical importance. This paper selects all Chinese A-share listed companies from 2012 to 2022 as samples, empirically investigating the correlation between digital transformation and firm performance. The results illustrate that digital transformation can not only directly contribute to firm performance, but also indirectly improve firm performance by driving green technology innovation. What's more, digital transformation affects firm performance differently because of heterogeneity. The positive impact is more significant in eastern firms, private firms and large-scale firms. Hence, firms should actively deepen digital transformation and green technology innovation; the government should develop incentive policies for digital transformation based on the actual situation of different firms.

Keywords: digital transformation, firm performance, green technology development

1 Introduction

As we all know, corporate performance has a significant impact on the company itself and society. To the company itself, high corporate performance can help companies improve their market competitiveness and creativity of employees. To the society, that can not only provide consumers with better goods and services, but also promote the sustainable development of society by reducing resource waste and improving energy efficiency. Although most of firms are actively formulating performance management systems, the development of corporate performance is still hindered by problems such as low development of technology and inadequate talent incentive mechanism.

Currently, China's digital economy is booming. <White Paper on China's Digital Economy Development (2022)> released by the China Information Institute points out that driven by the rapid improvement of 5G and the Internet technology, China's digital economy will reach 45.5 trillion yuan in 2021, accounting for 39.8% of GDP, so the

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digital economy has become the main power of stable economic growth. The government of China attach great importance to the digital transformation of traditional enterprises. They propose that China needs to promote the construction of a strong network country, activate the potential of data element and accelerate the improvement of digital economy, society and government. With the government support, more and more firms have tried to apply digitalization to their production and management in order to gain more dividends.

In terms of digital transformation's effect on firm performance, which is still controversial in academia. Findings of studies are mainly divided into four opinions, respectively positive impact (Li Xiaoyang et al.^[1], 2023; Chen Xv et al., 2023^[2]; Li Qingyang et al., 2023^[3]; Chen Chongyong & Xv Jinghan, 2020^[4]), negative impact (Nambisan, Satish, 2017^[5]), no significant impact (Qi Yudong & Cai Chengwei, 2020^[6]; Li Xiaoyu, 2019^[7]) and U-shaped relationship (Min Zehao. 2021^[8]). However, the existing literatures mainly investigated the effect of digital transformation on firm performance through channels like alleviating financing constraints, reducing agency problems, and overhead costs; and most of studies only investigate a certain industry which is not representative for the whole firms from different industries. Therefore, the possible contributions of this paper are: (1) This paper is on basis of data from all listed firms in China, which can get a more macroscopic conclusion. (2) This paper uses green technology innovation as a mediating variable, which responds to the "double carbon" policy of China and fills the empirical vacancy in the studies of enterprise digitalization. (3) This paper proposed some new policy recommendations in order to help the digital transformation and performance improvement of enterprises.

This research is divided into the following parts. First, we propose hypotheses based on the analysis of existing literature. Next, we use the data of Chinese A-share listed companies from 2013 to 2022 as samples to test the influence of digital transformation on firm performance and the mediating role of green technology innovation. Finally, we will give some theoretical suggestions based on the regression results.

2 Theoretical analysis and research hypothesis

2.1 Analysis of the effect mechanism of digital transformation on firm performance

According to existing studies, digital transformation can improve firm performance in several aspects: First, digital applications can improve the quality of products and services of firms. High-quality services and products can attract more new customers and improve satisfaction of existing customers. Second, the production and management cost of firms can be reduced by digital transformation. The Internet, big data, blockchain and other technologies can not only effectively replace manual work, reduce enterprise labor costs, but also reduce the production cycle and improve the product qualification rate; enabling enterprises to achieve high-volume, multi-species and personalized products and services at a lower cost (Liu Shuchun et al., 2021^[9]). Third, digital transformation can optimize the management structure of enterprises. Digital technology can flatten the company's organizational structure through decentralization, reduce

internal communication costs, maximize the potential of the company's employees, and improve the management and operational efficiency of the company. Fourth, digital transformation can promote corporate innovation. It has been shown that the characteristics of digital technology such as editable, expandable, innovative and relevant can improve the performance and competitive advantage of enterprises (Wang Haihua & Du Mei, 2021^[10]). Based on these above analyses, this paper reckons that the promotion effect of digital transformation on corporate performance is more obvious. Therefore, the following hypothesis is proposed :

H1: Digital transformation has a positive impact on enterprise performance

2.2 Analysis of the influence mechanism of digital transformation on green technology innovation

There is an argument about whether digital transformation can promote green technology innovation. Some scholars believe that digital transformation has a non-linear impact on corporate green technology innovation. (Wang Tingting et al., 2023^[11]). Other scholars believe that digital transformation is helping to drive green innovation (Jin Fang et al., 2021^[12]; Guo Feng et al., 2023^[13]; Jin Yu et al., 2022^[14]). Digital transformation could positively influence green technology innovation in the following three ways: First, the development of digitalization facilitates companies to improve their risk tolerance level. Digital technology breaks the time and space constraints of traditional industry competition, which means it can help companies access to some advantageous resources and stimulate them to research innovative risky activities. Innovating in green technology is a risky business to invest in, so the higher risk tolerance of enterprises, the more they can promote green technology innovation (Qi Huaijin & Liu Siqin, 2023^[15]). Second, digital development can alleviate the financing constraints of enterprises. The digital economy promotes financial industry clustering by connecting enterprises and creditors on the network, in which they can communicate and interact with each other in time and effectively solve the information asymmetry problem. Third, digital transformation can help firms attract more government subsidies (Xue L et al., 2022^[16]). Digital transformation in contemporary China is supported by government policies, and firm's digital development can help them attract more government subsidies, reduce the pressure of financing and loans, and bring a strong support to their innovation of green technology. Based on these analyses, this study argues that firm's digital transformation can significantly influence green technology innovation, so the following hypothesis is proposed:

H2: Digital transformation has a positive impact on green technology innovation

2.3 Analysis of the impact mechanism of green technology innovation on enterprise performance

According to existing researches, scholars hold different opinions about the effect of green technology innovation on firm performance, which are inhibitory effect (Yang Jing, 2015^[17]), non-linear effect (Jia Chunxiang & Zhang Yan, 2023^[18]), no significant effect (Chen Yuke, 2018^[19]) and positive effect (Wang et al., 2021^[20]; Zhu

Xianyu&Yang Yang, 2021^[21]). Green technology innovation can positively impact business performance in these following ways: First, green technology innovation helps companies reduce environmental damage. It can not only reduce the environmental protection fines that companies should pay for; but also let companies gain more social favorability and lay a solid foundation for their long-term growth. Second, green technology innovation can help companies invent some green products which respond the public needs. It is beneficial for enterprises to increase their market share and increase their monopoly profits. Third, green technology innovation can enhance the green human resource training and improve the green supply chain management of enterprises. It can improve firm performance by reducing management costs. (Zhu Xiangyu & Yang Yang, 2021^[21]). Based on these above analyses, this argues that the positive influence of innovation of green technology on firm performance is more pronounced, so the following hypotheses are proposed:

H3: Green technology innovation has an positive impact on enterprise performance

H4: Between digital transformation and business performance, green technology innovation plays a mediating role

3 Empirical model setting and data description

3.1 Empirical Model Setting

Empirical model setting of the benchmark regression.

In order to check the influence of digital transformation on firm performance, we construct the following empirical model:

$$EP_{it} = \alpha_0 + \alpha_1 DT_{it} + \alpha_2 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

In this model, the explanatory variable EP denotes enterprise performance; the key interpreted variable DT is degree of digital transformation of the enterprise; X is the matrix of control variables; ε is the random error; i denotes the firm; and t denotes the year. In addition, this paper controls the effects of individual μ and year λ . According to the previous theoretical analyses, if the α_1 's coefficient is significantly positive in model (1), then H1 in this paper can be verified.

Empirical model setting of mediator effect regression.

To test the mediator effect of innovation of green technology in the impact of digital transformation on firm performance, we construct the following empirical model.

$$GTI_{it} = \beta_0 + \beta_1 DT_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

$$EP_{it} = \theta_0 + \theta_1 DT_{it} + \theta_2 GIT_{it} + \theta_3 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (3)$$

According to the test of mediating effect proposed by Wen Zhonglin and Ye Baojuan (2014)^[22]. If both β_1 and θ_2 are significant, the H2 can be certified.

3.2 Variable selection and data description

Explained variable.

The explained variable in this paper is firm performance(FP). This paper refers to the tests of Hu Dongbin & Zhoupu(2023)^[23] and Ye Chengang et al., (2016)^[24] using return on equity(ROE) to measure the level of enterprise performance(EP). Return on assets(ROA) and EBIT margin on sales(EBITmargin) are selected as alternative variables for ROA for robustness tests.

Key Interpreted Variable.

The key interpreted variable of this study is digital transformation(DT). In recent years, most of scholars used texture analysis method to count digital transformation keywords to portray the level of digital transformation(Li Qingyang et al., 2023^[3]; Wu Changqi et al., 2022^[25]). This paper refers to Li Xiaoyang et al.(2023)^[1]using the digital transformation degree in CSMAR database to measure the digitalization level of firms, which is also based on the texture analysis method.

Mediating variable.

The mediating variable in this paper is green technological innovation(GTI). This paper refers to Guo Feng et al.(2023)^[13] uses data of the number of green invention patent applications to measure the degree of green technological innovation of enterprises.

Control variables.

In order to avoid the empirical test errors caused by omitted variables, according to the existing researches of scholars(Li Qingyang et al.,2023^[3]; Qi Yudong & Cai Chengwei, 2020^[6]) and the actual needs of this paper, this paper introduce some control variables that may have some impacts on firm performance. They are first shareholder's ownership(Top1), enterprise leverage ratio(Lev), board size(Board), dual position (Dual), enterprise growth(Growth), and current asset turnover ratio(CAR). In addition, this paper controls for year(year) and individual(code) effects. Each variable is defined and described in Table 1

Table 1. Definition and description of variables

Variable Type	Variable Name	Variable Symbols	Variable Description
Explained variables	return on equity	ROE	net income / average annual equity
	EBIT margin on sales	EBIT margin	EBIT / Sales Revenue
	return on assets	ROA	net profit / average annual assets
Core explanatory variables	degree of digital transformation	DT	natural logarithm of the sum of keywords include artificial intelligence technology, blockchain technology, cloud computing technology, big data technology, digital technology application in the annual report of the enterprise plus 1

	digital transformation index	DTiv	0.3472*strategy-driven score + 0.162*technology-enabled score + 0.0969*organization-enabled score + 0.0342*environment-enabled score + 0.2713*digital outcome score + 0.0884*digital application score, each sub-division is a standardized value
Intermediate variables	green technology innovation	GTI	natural logarithm of the number of green invention patent applications of enterprises plus one
	current assets turnover ratio	CAR	current assets/total assets
Control variables	enterprise growth	Growth	enterprise main business income growth rate
	first shareholder's ownership	Top1	number of shares held by the largest shareholder / total number of shares
	leverage ratio	Lev	total liabilities / total assets
	board size	Board	natural logarithm of the number of board members plus 1 if chairman of the board and the managing director are the same person, take 1, otherwise 0
	dual position	Dual	state-owned enterprises take 1, otherwise take 0
	nature of ownership	SOE	natural logarithm of total corporate assets
	enterprise size	Size	

Sample selection and data sources.

This paper selects all A-share listed companies in China from 2013 to 2022 as the research objects. This paper processed the data as follows: (1) removed the sample of firms in financial sector. (2) deleted the sample of firms with ST and PT treatment. (3) deleted the sample with serious missing core variables. (4) performed a one-percent tailing process for the remaining sample. In the end, there are 24450 final samples obtained. All the data in this paper are searched from CSMAR database. Descriptive statistics are shown in Table 2.

Table 2. Descriptive statistics of variables

Study variables	Sample size	Average value	Standard deviation	Minimum value	Maximum value
ROE	23554	0.056	0.121	-0.735	0.396
ROA	23556	0.031	0.0578	-0.302	0.197
EBITmargin	23955	0.095	0.164	-0.992	0.655
DT	24208	1.209	1.320	0	5.030
DTiv	21153	0.368	0.103	0.233	0.655
GTI	21786	0.764	1.036	0	4.407
Top1	20594	0.333	0.142	0.088	0.724
Lev	23551	0.441	0.199	0.061	0.931
Board	23776	2.122	0.188	1.609	2.639
Dual	24028	0.248	0.432	0	1
Growth	23560	0.203	0.503	-0.642	4.825
CAR	23566	0.550	0.194	0.095	0.948
Size	23559	22.410	1.254	19.790	26.410
Soe	24028	0.378	0.485	0	1
Number of code	2436	2436	2436	2436	2436

4 Empirical Results and Analysis

4.1 Benchmark Regression

Table 3. Benchmark regression results

	(1) ROE	(2) ROE	(3) ROE
DT	0.005*** (0.0010)	0.003*** (0.0011)	0.003*** (0.0011)
Lev		-0.221*** (0.0078)	-0.212*** (0.0080)
Growth		0.0311*** (0.0017)	0.0308*** (0.0017)
Top1		0.126*** (0.0134)	0.120*** (0.0136)
Board			0.0108 (0.0074)
Dual			0.0046* (0.0025)
CAR			0.085*** (0.0085)
Constant	0.071*** (0.0024)	0.112*** (0.0064)	0.036** (0.0178)
Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Sample size	23315	19451	18893

In this subsection, we construct a benchmark regression to test the correlation between digital transformation and firm performance, and the findings are illustrated in Table 3.

In each column, the fixed effects of individual and time are added. Column (1) shows the regression result without control variables, and we can find that the coefficient of digital transformation is 0.005, which is significant at 1% confidence interval. Column (2) and column (3) respectively include three control variables and six control variables, the coefficients of digital transformation of these two regressions are both 0.003, which are significant at 1% confidence interval. thus, these three regression findings illustrate that digital transformation has a positive effect on firm performance and H1 can be certified.

4.2 Robustness test

To verify the robustness of the benchmark regression results, we conducted robustness tests by taking endogeneity test, replacing the explanatory variables, and changing the sample intervals. The regression findings are demonstrated in Table 4.

Table 4. Robustness type test

	(1) ROE	(2) ROA	(3) EBITmargin	(4) ROE(2017-2022)
DT	0.004** (0.0018)	0.002*** (0.0005)	0.003* (0.0014)	0.003* (0.0018)
Constant	0.231***	0.021***	0.084***	0.125***

	(0.0347)	(0.0079)	(0.0225)	(0.0294)
	Phase I Regression			
DTiv	10.240***			
	(0.1170)			
Weak IV test	Pass			
Control variables	Control	Control	Control	Control
Individual fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Sample size	18584	18842	18732	10654

Endogeneity test.

Considering the possible endogeneity problem of reverse causality between the explanatory and the explained variables in this paper, we take the instrumental variable method to test this problem, and the digital transformation index (DTiv) is selected as the instrumental variable. This variable scores the digitalization of firms in six aspects: strategy-driven, technology-enabled, organization-enabled, environment-enabled, digital outcome and digital application, and the digital transformation index is the standardized value of each segmented index. The higher the score of each index, the higher the acceptance of digital transformation of firms, theoretically this index is highly correlated with the degree of firm's digital transformation; and the influence of each aspect of the index on the control variables of the model is small, so the digital transformation index satisfy the conditions of instrumental variable. The two stages of the instrumental variable regressions are illustrated in column (1). The instrumental variable's coefficient on digital transformation in the first stage is 10.240, which is significant within the 1% confidence interval and passes the test of weak instrumental variable. In the second stage of the regression, the coefficient of digital transformation is 0.004, which is significant at 5% confidence interval, demonstrating that the positive relationship of digital transformation on firm performance still exists.

Replacement of explanatory variables.

This paper replaces the explanatory variables return on equity (ROE) with return on assets (ROA) and EBIT margin on sales (EBITmargin) to take benchmark regression. Columns (2) and (3) illustrate that the coefficients of digital transformation are 0.002 and 0.003 respectively, and are significant at 1% and 10% confidence intervals. It indicates that the positive influence of digital transformation on firm performance is robust.

Replacement of sample interval.

Considering the low level of digital development in China from 2013-2016, the samples from 2017-2022 are selected for regression again. As demonstrated by column (4), the coefficient of digital transformation is 0.003, which is significant at 1% confidence interval. It illustrates that digital transformation still has a significant promoting influence on firm performance after changing the sample interval.

4.3 Heterogeneity analysis

The effect of digital transformation on performance is different for firms with different region, ownership nature and size. Therefore, heterogeneity regressions are conducted for these three aspects, and the findings are illustrated in Table 5.

Table 5. Heterogeneity analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ROE (west)	ROE (central)	ROE (east)	ROE (state)	ROE (private)	ROE (large)	ROE (small)
DT	-0.003 (0.0032)	0.0004 (0.0027)	0.005** * (0.0013)	0.0003 (0.0017)	0.004** (0.0014)	0.002* (0.0014)	0.002 (0.0019)
Constant	0.060 (0.0521)	0.053 (0.0429)	0.026 (0.0213)	0.036 (0.0274)	0.031 (0.0237)	0.113** * (0.0245)	-0.034 (0.0293)
Control variables	Control	Control	Control	Control	Control	Control	Control
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	2258	3352	13283	7415	11478	11002	7891

Regional heterogeneity.

Companies in different regions have different geographical advantages and government incentive policies, leading to different attitudes to the digital transformation. In the central and western regions, the economic development is slow. Firms will not invest a large amount of money in innovative activities such as digital transformation in order to survive. Even if some companies in these areas accept innovation and invest money in digital transformation, they will not be able to form economies of scale because of the low local demand for digital products and services, which leads to digital transformation does not have an impact on enterprise performance or has a negative impact. In the eastern region, the economic development is fast and the international trade is booming, so the competition among enterprises in the eastern region is more intense. Most of enterprises are willing to invest in digital transformation because it can improve the competitiveness of firms. In addition, the digital economy has formed economies of scale in this region, so the digital transformation of firms will probably help them reduce production and management costs. Therefore, digital transformation can improve to the performance of firms in the eastern region. To test the above hypotheses, this paper designs empirical regressions of regional heterogeneity. From the results in columns (1) and (2), it illustrates that the coefficients of the degree of digital transformation in the central and western regions fail to pass the significance test. The result from column (3) demonstrates that the coefficient of digital transformation of eastern enterprises is 0.005 and passes the significance test of 1%. These regressions

verify that there is significant positive influence of digital transformation on firm performance in eastern region, while the effect is not significant in other regions.

Enterprise nature heterogeneity.

The performance and the digital transformation of enterprises with different ownership nature may also be different, mainly because of their survival pressure and their different internal talent promotion structure. State-owned enterprises have less pressure to survive because of government support, so they may have less innovation awareness; in addition, state-owned enterprises have less efficiency in technology innovation, because there are a large exodus of skilled workers from state-owned enterprises due to inflexible promotion mechanism, so the investment in digital transformation may not necessarily promote the enterprise performance. For private enterprises, due to less government subsidies, frequent financing constraints, and greater competition among enterprises, they will vigorously innovate and develop digital transformation; in addition, the internal promotion mechanism of private enterprises is more flexible, which can attract a large inflow of talents and promote the efficiency of digital transformation, and is more likely to increase the utility of enterprise performance. To test the above hypotheses, this paper designs an empirical regression. From column (4), it demonstrates that the coefficient of digital transformation of state-owned firms does not pass the significance test. From column (5), the coefficient of digital transformation of private firms is 0.004, which is significant at 5% confidence interval. These regressions verify that the digital transformation can improve the performance in private firms, while it is not significant in state-owned firms.

Enterprise size heterogeneity.

For large-scale enterprises, they have sufficient capital reserves, advanced technology and talents, which can help them to carry out digital innovation more smoothly and bring about growth in company performance. For small-scale firms, the process of digital transformation is slow and hardly has a significant impact on firm performance, mainly because they do not have sufficient capital reserves to invest in technology and personnel. To test these above hypotheses, this paper designs empirical regressions of firm size heterogeneity. From column (6), the coefficient of digital transformation of large-scale firms is 0.002 and significant at 10% confidence interval. From column (7), the digital transformation's coefficient for small-scale firms does not pass the significance test. These regressions verifies that digital transformation can promote performance in large-scale firms, while the impact on the performance of small-scale firms is not significant.

4.4 Mediator effect regression

In order to test the mediating effect of green technology innovation in the impact of digital transformation on firm performance, this paper used mediation effect regression to verify. The findings of the mediating effect regression are illustrated in Table 6.

Table 6. Intermediary effects regression

	(1) ROE	(2) GTI	(3) ROE
DT	0.003*** (0.0011)	0.035*** (0.0067)	0.003*** (0.0011)
GTI			0.002* (0.0013)
Constant	0.036** (0.0178)	0.362*** (0.1090)	0.032* (0.0180)
Control variables	Control	Control	Control
Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Sample size	18893	18938	18707

In table 6, column (2) replaces enterprise performance(ROE) with green technological innovation(GTI), and the result shows that the coefficient of digital transformation is 0.035, which is significant at 1% confidence interval. So digital transformation of firms can improve the innovation of green technology, which proves H2. Column (3) regresses firm performance, green technological innovation and digital transformation jointly, the result illustrates that the coefficients of digital transformation and green technological innovation are 0.003 and 0.002 respectively, and are significant at 1% and 10% confidence intervals, indicating that green technology innovation plays a partially mediating role in the impact of digital transformation on firm performance, certifying H3 and H4 are valid.

The mediator effect of the innovation of green technology is reflected in the digital transformation can promote the development of digital finance of enterprises, broaden financing channels, alleviate green financing constraints and enhance the development of green technology innovation; and the green technology innovation can influence the enterprise performance by the following two ways: first one is that innovation of green technology can help firms form market monopoly by new green inventions; what's more, it can attract the government green subsidies to increase enterprise performance.

5 Conclusion and Recommendation

Based on the theoretical analysis of the relationship between digital transformation and firm performance, this paper verifies the hypotheses proposed in the previous section with the help of data of Chinese A-share listed firms from 2013 to 2022, and obtains the following conclusions:

First, there is a positive effect of the degree of digital transformation on the development of corporate performance, and this finding passes the robustness tests of instrumental variables, replacement of explanatory variables and replacement of sample intervals. Second, the mediator effect regression finds that as well as directly helping to improve firm performance; digital transformation can also have an indirect impact on how companies perform by facilitating the improvement of green technology innovation, which means digital transformation can promote the innovation of green technology and then contribute to the development of firm performance. Third, the heterogeneity findings illustrate that the impact of digital transformation on firm performance

varies across different enterprises; among them, the digital transformation of eastern regional firms, privately owned firms, and large-scale firms has a more significant effect on the promotion of firm performance.

Based on the above research results, in order to promote firms to achieve digital transformation and improve their performance, this paper puts forward the following suggestions: First of all, firms should deepen their digital transformation strategies. The empirical results of this research show that digital transformation is catalytic to firm performance, which can help firms allocate resources effectively and reduce their organizational and production costs. Firms should seize the opportunity of today's rapid development of digitalization and deeply integrate digital technology into their production management system to lay the foundation for rapid and sustainable development of enterprises. What's more, firms should attach importance to green technology innovation. The empirical results of this paper demonstrate that green technology innovation has a certain promotion effect on enterprise performance, and digital transformation can support enterprise green technology innovation. In the context of "double carbon" target of China, the innovation of green technology can not only improve the competitiveness of firms, but also help them attract more government subsidies. Third, the government should strengthen incentives for the digitalization of firms, especially in the central and western regions, state-owned firms, and small-scale firms. Existing government incentives are the same for all firms and are not tailored to the different characteristics of each company, so incentive efficiency is relatively slow. Therefore, government incentives should be implemented according to different conditions of firms. For central and western firms, government should implement more subsidies for digital transformation and provide technical support to these local firms. For state-owned firms, government should encourage them to optimize internal human resource management and open a new promotion route for talents. Letting state-owned firms put more investments into the salary of technical talents, and implement a more flexible salary system with them, which is conducive to improving the work efficiency of technical talents and reducing the turnover rate. For small-scale firms, government should provide more subsidies to them, and optimize the treatment and subsidies for employees of small-scale firms.

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