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Research on the impact of digital infrastructure construction promotion policies on enterprise digital transformation

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Abstract

In the 21st century, emerging digital technologies such as artificial intelligence and big data have had a huge impact on human society, and since the 18th National Congress of the Communist Party of China, the digital economy has gradually become an important engine for China's economic development. This paper collects data on China's provincial digital infrastructure policies and A-share listed companies during 2011-2020 to empirically test the impact of digital infrastructure promotion policies on enterprises' digital transformation. According to the results of mathematical analysis, digital infrastructure promotion policies can help Chinese enterprises to carry out digital transformation and optimize their digital application capabilities. The conclusions of this paper not only enrich the academic research fields related to digital economy and industrial organization but also provide certain decision-making basis and path reference for China's future digital infrastructure policy.

Keywords: *Digital infrastructure, Business management, digital transformation*

1. INTRODUCTION

With the advent of the information age, the digital economy has been integrated with China's service industry, new media industry, education industry, etc., and the rapid development of the digital economy also puts forward further requirements for the popularization and optimization of digital infrastructure. Since the beginning of the financial crisis in 2008, the global economy has been sluggish. In recent years, with the Sino-U.S. trade friction and the outbreak of the novel coronavirus epidemic, the anti-globalization trend of thought is surging, and the great power game is constantly playing. These impacts have brought great challenges to the sustained and healthy development of China's international circulation and economy. As early as 2017, Chinese government departments began to pay attention to the "Sinicization" of the digital economy and wrote it into the government work report. The Overall Layout Plan for Digital China Construction issued by the Central Committee of the Communist Party of China and The State Council emphasizes the need to consolidate the foundation of digital China construction and open up the major arteries of digital infrastructure. At the same time, the "Notice of The State Council on the issuance of the" 14th Five-Year Plan "for the development of the digital economy clearly states that it is necessary to carry out the pilot of universal telecommunications service. The 14th Five-Year Plan and the 2035 Vision Target outline also point out that the digital economy will "empower the transformation and upgrading of traditional industries and foster new industries, new business forms and new models."

Based on the historical background and policy guidance, it can be seen that digital transformation has become the only way for domestic enterprises to achieve high-quality development. Of course, the digital transformation of enterprises will certainly face many challenges, such as job changes and fluctuations in the number of employees brought about by digital transformation, which requires enterprises to effectively protect the relevant rights and interests of employees while smoothly carrying out the transformation, maintain good and smooth communication with them, and make corresponding response strategies to job changes [i]. Secondly, how to ensure the security of customer information, enterprise information, and other trade secrets in the process of digital transformation, and regulate the overall information use and management of the company under the premise of complying with relevant laws? In addition, under the requirements of information sharing, small and medium-sized enterprises still have a wide range of independent behavioral decisions based on short-term interests or short-sighted analysis, which seriously affects the cooperation and communication between enterprises and still retains the

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traditional extensive management model [ii]. Therefore, if enterprises simply rely on the market mechanism to promote the digital transformation of enterprises or will face problems such as "coordination failure", and how to better play the role of the government to drive the digital transformation of enterprises has become the focus of attention of all sectors of society. Of course, the trend of enterprise digital transformation should not be hindered by these unfavorable factors, which requires the government to further weigh the use of market mechanism and government control, so that the two become the wings of the bird and the two wheels of the car to promote the development of enterprises and even the market.

2. Literature review

2.1 The impact of digital infrastructure construction on enterprises' digital transformation

In terms of the impact of digital infrastructure on enterprises' digital transformation, domestic and foreign scholars mainly discuss from two aspects: business model and technology. In terms of enterprise operation mode, digital transformation promotes the transformation and upgrading of business model by efficiently analyzing and processing massive data and integrating the information database required by enterprises through digital technology. From the technical point of view, domestic scholar Liu Pan et al. (2021), based on the validation of the multidimensional fixed effect model, pointed out that digital technology has changed the traditional market information prediction method of the supply chain market, but has conducted more reliable and accurate analysis based on big data, which has greatly improved the connection between the supply chain and the response speed [iii]. The radical change in the actual operation mode brought by it also strengthens the ability of enterprises to adapt to the external business environment and market competition through the coordinated allocation of internal and external resources [iv], so as to better play the collaborative allocation between supply chain enterprises and other node industries of the whole industrial chain, and achieve the industrial effect of 1+1>2 [v]. It also enables the supply chain to continuously expand the depth and breadth of its terminals, enabling it to transform into a multifunctional complex network node model with the support of digital technology [vi]. In addition, along with the extensive application of digital elements such as cloud computing and big data, Ye Yongwei et al. (2023) pointed out by calculating the difference in the digital inclusive financial index that the traditional financial field has gradually broken through the traditional operation mode of intermediary bridge and carried out digital transformation, greatly reducing the information inequality between the supply and demand sides of the financial market through the massive data of the Internet. The cost of corporate loans has been reduced.

2.2. Why do companies need digital transformation

For the reasons of enterprise digital transformation, scholars mainly discussed from three aspects: enterprise operation, organizational structure, and supply chain impact. First of all, enterprise digital transformation not only disrupts the way of establishing and maintaining relationships with various stakeholders, business development, and business model, but also promotes business model innovation and customer value creation. This is because for the enterprise itself, digital transformation can improve the operation and management efficiency of the enterprise. As an effective means of processing massive data, digital technology can make use of information at low cost and high efficiency. With the help of advanced technologies such as artificial intelligence, information can be aggregated, classified, and comprehensively analyzed to assist managers to make corresponding decisions. Secondly, based on the evidence of A-share listed companies, some scholars have proposed that digital transformation makes the organizational form of enterprises more flexible, flexible and loosely coupled, and the change of organizational mode has A profound impact on the overall strategic planning and business performance of enterprises, and has a greater impact on enterprise innovation. Third, digital transformation can accelerate the response speed between supply chain enterprises and accelerate the integration process of innovation elements. Traditional methods based on planning and forecasting algorithms have been unable to accurately predict market demand information and strategic investment direction of enterprises, so as to improve the stability of supply chain and provide a long-term and stable cooperation environment for collaborative innovation of supply chain enterprises. In addition, digital technology can combine the actual situation of enterprises to efficiently identify the resources required and suitable for enterprise innovation, enhance the transparency of information resources between enterprises [vii], reduce information asymmetry, and help enterprises find more valuable innovation resources.

3. Theoretical mechanism and research design

3.1 External environment

Most enterprises are limited by the lack of cutting-edge information access, start-up capital, technical support, and other aspects, and it is difficult to break through the barriers of digital transformation. Therefore, it is essential to effectively promote the support of enterprise transformation resources through external intervention to guide enterprises to carry out correct and efficient digital transformation. Based on this requirement, digital infrastructure policies can accelerate enterprises' access to transformation resources through channels such as government subsidies, credit support, and technical talents, and build a solid technical and financial "base" for enterprises' digital transformation. In terms of the detailed path, with the introduction of the digital infrastructure policy, more digital popularization projects will be promoted, such as information technology training for enterprise employees, intelligent updating of enterprise equipment, etc. At the same time, local governments will give certain government subsidies to enterprises carrying out such projects, so as to play the "leverage role" of financial funds. Solving the biggest obstacle to digital transformation is "capital".

3.2 Internal dynamics

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For the digital transformation of enterprises, the ability to attract technical talents with digital technology application and research and development capabilities is crucial. With the implementation of digital infrastructure policies, the development of relevant digital industries will create more high-skilled jobs, induce the transformation of the regional labor demand structure, and result in the rapid accumulation of talents with digital knowledge and related skills, thus providing the necessary talent support for the digital transformation of enterprises. For businesses, advancing digital transformation requires significant capital investment and can incur precipitated costs that hinder digital-related experimentation. However, the digital infrastructure promotion policy has the ability to improve the business conditions of enterprises, strengthen the internal capacity building, and then stimulate the digital transformation of enterprises, which can help guide enterprises to choose targeted digital transformation paths, so as to avoid possible risks and losses to a certain extent.

Overall, digital infrastructure policies can provide enterprises with transformation resources through government subsidies, credit support, technical talents, and improve the level of market competition and software and information technology services, so as to optimize the external transformation environment faced by enterprises. It can also improve the business conditions of enterprises to enhance the internal ability of enterprise transformation, so as to help its digital transformation in the two paths of external environment optimization and internal motivation.

According to the above theoretical mechanism, the core explanatory variable of this paper, digital infrastructure construction promotion policy, was manually compiled by the author on major government websites. The explained variable was based on the panel data of A-share listed companies in the Guotai 'an database for A total of 10 years from 2011 to 2020 and was obtained by eliminating ST samples and 1% tailing of continuous variables according to the relevant empirical methods of other scholars. The remaining control variables are derived from major statistical yearbooks.

4. variable definition

4.1 Digital Infrastructure Promotion Policy

According to the 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Outline of the 2035 Vision Goals, infrastructure construction mainly includes two aspects: integrated infrastructure and information infrastructure. Based on the relevant methods proposed by Sun Bopeng (2023) and Liu Chong, and based on the comprehensive consideration of data availability, keywords such as digital economy, cloud computing, Internet of Things, meta-universe, artificial intelligence, and digital platform are selected to screen relevant policies from various government websites and manually organize and download them. After reading the selected policy documents, documents unrelated to this study are deleted. Finally, the number of digital infrastructure construction promotion policies (*policy*) is selected as the core explanatory variable of this paper. Due to the time lag in the formulation and implementation of policies, the first-stage lag variable of the core explanatory variable of this paper is used in the model for actual regression.

4.2 Enterprise digital transformation

Song Hua and Han Siqi (2022) [viii] et al pointed out that digital technologies such as cloud platform and artificial intelligence are gradually reshaping the core underlying architecture of enterprise digital transformation. In view of this, after further referring to the relevant methods of Chinese and foreign scholars, this paper takes the occurrence frequency +1 of the five keywords related to "big data", "artificial intelligence", "blockchain", "cloud computing" and "digital technology application" in the annual report of the sample enterprises, and then takes the final logarithmic value to measure the digital transformation degree of the explained variable enterprises in this paper (*digital*).

4.3 Control variable

After comprehensively considering data availability and relevant research methods of other scholars, this paper refers to the annual reports of sample enterprises and selects two dimensions of enterprise characteristics and financial situation as the measurement dimension of control variables. Among them, enterprise characteristics include the number of employees (*size_emp*) and age (*age*) of enterprises. The financial situation includes four indicators: debt ratio (total liabilities/total assets) (*leverage*), cash flow (cash), fixed assets ratio (total fixed assets/total assets) (*fixasset*), capital intensity (assets/operating income) (*captian*) and profitability (net profit/total assets) (*roa*).

5. model construction

The following model is constructed based on the above model variables.

$$digital_{it} = \beta_0 + \beta_1 policy_{it-1} + \omega x_{it} + \tau_t + \mu_i + \varepsilon_{it}$$

Where I represents the sample, t represents the time, is the control variable, is the time-fixed effect, is the sample-fixed effect, and is the disturbance term.

Table 1 Descriptive statistics of variables

Variable	Mean	Standard deviation	Minimum	Maximum
digital	.97	1.183	0	4.419
policy	4.024	3.895	0	16
size emp	7.783	1.16	5.384	11.025
age	17.468	5.464	5	32
leverage	.402	.192	.055	.861
fixasset	.244	.148	.019	.695
capinten	2.241	1.473	.475	9.567

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roa	.039	.059	-.223	.195
cash	.169	.115	.016	.573

6. Empirical result analysis

The following regression results are the basic regression of this paper, among which (1) are the regression results without adding other control variables, (2) are the regression results after adding the control variables of enterprise characteristics, and (3) are the complete regression results after adding the control variables of enterprise characteristics and financial status.

Table 2 Analysis of the impact of digital infrastructure construction promotion policies on enterprises' digital transformation

Variable	(1)	(2)	(3)
	digital		
policy	0.00500*	0.00505*	0.00510*
	(0.00209)	(0.00207)	(0.00207)
size_emp		0.189***	0.171***
		(0.0176)	(0.0184)
age		-0.0804**	-0.0804**
		(0.0263)	(0.0259)
leverage			0.151*
			(0.0707)
fixasset			-0.693***
			(0.0963)
capinten			-0.00176
			(0.00824)
roa			-0.0522
			(0.148)
cash			-0.308***
			(0.0837)
_cons	0.945***	0.881	1.186*
	(0.00990)	(0.480)	(0.480)
Time fixation	Yes	Yes	Yes
Sample fixation	Yes	Yes	Yes
R^2	0.727	0.730	0.731
adj. R^2	0.679	0.682	0.684

Note: * * and * * * respectively indicate that the estimated values of the parameters are statistically significant at the level of 10%, 5%, and 1%; Standard error in parentheses.

As can be seen from the regression results of this paper, regardless of whether control variables are added or not, the main coefficients of concern in this paper are positive, which indicates that the promotion policy of digital infrastructure construction is conducive to the digital transformation of enterprises. After adding other control variables, the number of employees also has a relatively significant positive correlation with enterprise digital transformation. This may be due to the fact that companies that tend to be able to hire more employees have deeper financial resources, which in turn enables them to buy the equipment and facilities needed for digital transformation. However, the enterprise survival time is negatively correlated with enterprise digital transformation. This may be due to the fact that longer-lasting businesses are more bound by experience, while new start-ups are more transformative. The fixed assets ratio is also significantly negatively correlated with digital transformation. This may be due to the fact that the proportion of fixed assets is too large, which makes the enterprise lack of working capital that can be used for digital equipment purchase, digital training of employees, etc. Surprisingly, the amount of cash held is also significantly negatively correlated with the digital transformation of enterprises, which may be due to the existence of liquidity traps that make enterprises prefer to preserve cash rather than invest.

6.1 Robustness test

Considering that there may be reverse causality between the explained variable and the core explanatory variable in this paper, that is, the promotion policy of digital infrastructure construction may also formulate and implement relevant targeted policies according to the degree and effectiveness of digital transformation of local enterprises. Thus, the estimation results of this paper are biased. In view of this, this paper makes reference to the relevant studies of Wang Hai and Yuan Chun (2021) [ix][x] et al., and conducts robustness test by replacing explanatory variables and explained variables. Specifically, the number of digital infrastructure construction promotion policies (*wpolicy*), the cumulative total effectiveness of digital infrastructure construction promotion policies (*twpolicy*), and the total number of digital infrastructure construction promotion (*tnpolicy*) are reestimated as new explanatory variables.

As can be seen from the regression results below, the results are relatively stable.

Table 3 Robustness Test 1

Explanatory variable	(1)	(2)	(3)
	digital		
wpolicy	0.00253*		
	(0.00124)		
tnpolicy		0.00462***	
		(0.000798)	
twpolicy			0.00156***
			(0.000440)

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R^2	0.731	0.732	0.732
adj. R^2	0.684	0.685	0.684

Note: * * and * * * respectively indicate that the estimated values of the parameters are statistically significant at the level of 10%, 5%, and 1%; Standard error in parentheses.

As for the explained variables, this paper refers to the research of relevant foreign scholars [xi], and selects the number of industrial robots as the robustness test variable for enterprise digital transformation, because industrial robots are essential tools and equipment for modern advanced manufacturing industry, which reflects the degree of intelligent and automated transformation of enterprises to a considerable extent. Specifically, the selection of the number of industrial robots per capita in prefecture-level cities as the newly interpreted regression is also robust from the results.

Table 4 Robustness test 2

	(1)
	robot_IFR
policy	0.00026*
	(0.000149)
R^2	0.683
adj. R^2	0.626

For the verification of instrumental variables, this paper draws on the Tian pigeon [xii] method and uses the interaction term between the number of prefecture-level cities of "eight vertical and eight horizontal" optical cable trunk lines and the level of optical cable construction as the instrumental variable of the promotion policy of digital infrastructure construction. Specifically, the cable trunk network is the basic framework of China's communications network, and it is also the basis for the government to invest in other digital infrastructure.

Table 5 Robustness Test 3

	(1)	(2)
	policy	digital
IV	0.170*	
	(0.014)	
Policy_IV		0.043*
		(0.02)
Control variable	Yes	Yes
Time fixation	Yes	Yes
Sample fixation	Yes	Yes

Note: * * and * * * respectively indicate that the estimated values of the parameters are statistically significant at the level of 10%, 5% and 1%; Standard error in parentheses. The Cragg-DonaldWaldF statistic for the weak tool identification test is 65.041, and the statistic for the F-test is 82.470

It can be seen from the regression results of instrumental variables that instrumental variables have a significant impact on digital infrastructure promotion policies, and the weak instrumental variable test and F-test also confirm the rationality of the selection of instrumental variables.

7. Conclusions and policy recommendations

With the accelerating evolution of economic globalization and information technology, governments at all levels of our country have also issued various types of digital development promotion policies, better in line with modern development, and strive to make the digital economy a new engine to promote our country's economic development. Based on the quantitative research of A-share listed companies and government policy data, this paper finds that the government's promotion of policy digital infrastructure construction has A significant positive promoting effect on the digital transformation of enterprises.

In addition, the conclusions of this study can provide useful policy implications for promoting enterprise digital transformation and digital China construction in the new era. Specifically, in terms of policy formulation, the government should continue to improve the regional digital infrastructure system, further integrate the new trend of international digital technology changes, and lead enterprises and even all market players into the digital economy more widely with forward-looking and targeted policies. Focus on the deep integration of digital infrastructure and all walks of life, enrich the development and application scenarios of new generation digital technologies, and further promote digital transformation, so that enterprise development resonates with the national strategic needs. By increasing the supply of public services such as underlying technology, data resources and software applications, enterprises can be promoted to the cloud and the platform, thus solving the problems of large investment in the early stage of digital transformation and slow short-term results. At the policy implementation level, local governments should also accelerate the promotion of regional digital industrialization. Increase support for related industries, formulate special industrial policies, and take concrete actions to "empower" the digital transformation of the entire economic and social field while accurately boosting the rapid development of emerging industries such as cloud computing, artificial intelligence and blockchain.

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