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The Development of Computing Power Enables the Digital Transformation of Industries in Langfang

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ABSTRACT
This paper uses 184 large-scale enterprises in Langfang City from 2014 to 2024 as research samples to construct a benchmark regression model for empirical analysis of the impact of computing power development on the digital transformation of industries in Langfang City. The research findings indicate that the development of computing power in Langfang City facilitates the digital transformation of industries, and the results are robust. Based on the findings, policy recommendations are proposed from both government and enterprise levels to promote the development of computing power in the Langfang region and enhance the efficiency of leveraging computing power for industry digital transformation, aiming to provide policy suggestions for local governments to utilize computing power technology to promote industrial digital transformation.

KEYWORDS
Computing power; Industrial transformation; Digitalization

1 Introduction

The development of computing power can enhance the level of technological advancement, accelerate the digital transformation of industries, and create new advantages for the digital economy. It is a primary driving force for high-quality economic development and helps China build a new development pattern featuring "dual circulation." With the rapid development of China's computing power, the digitalization of industries and the industrialization of digital technologies have become the main drivers of high-quality economic growth. The digitalization of industries primarily involves transforming low-value-added, high-energy-consuming traditional sectors into intelligent and digitalized entities. Computing power empowers the digital transformation of industries in Langfang, blurring industry boundaries and promoting the ecological and intelligent development of production relations, driving the digitalization of production factors and tools. On the production side, the development of computing power can break down production processes into smaller segments, effectively improving the skill levels and sense of responsibility of workers in each segment, reducing corporate production costs, and encouraging companies to produce diversified, differentiated, and personalized products. On the trading side, the development of computing power shortens product transaction times and reduces transaction costs. The development of computing power facilitates the digital transformation of industries, optimizes resource allocation within industries, significantly enhances corporate productivity, unleashes industrial innovation capabilities, and promotes the development of social productivity. Traditional industries in Langfang have already recognized that the digital transformation of industries is key to enhancing competitiveness. Based on this, this paper conducts an in-depth study on how the development of computing power empowers the digital transformation of industries in Langfang. According to the research conclusions, it proposes policy recommendations with reference value to promote the digital transformation of industries in Langfang.

2 Indicator selection, model construction and indicator selection

2.1 Indicator selection

2.1.1 Explanatory variables

The Development Index of Computing Power (COMP) in this paper mainly follows Wang Huijuan's (2024) approach, setting the Langfang City Computing Power Development Index as a primary indicator. The secondary indicators include Langfang City's computing power infrastructure, computing power technology level, and computing power industry application. Under each secondary indicator, several tertiary indicators are set. The specific index system for computing power is shown in Table 1. This paper primarily uses the entropy weighting method to calculate the Langfang City Computing Power Development Index, and missing values are estimated using the mean interpolation method.

Table 1 Index system of computing power development index in Langfang City

Primary indicators	Secondary indicators	Tier 3 indicators	Indicator definitions	attribute
Computing power development index	Computing infrastructure	Computing power scale	The floating point computing power of the CPU in use	+
		network environment	The amount of data that can be transmitted over the network per unit of time	+
	Level of computing power and scientific innovation	scientific research input	R&d expenditure as a percentage of GDP	+
		Innovation level	Number of invention patents granted	+
	Integration of computing power industry	Computing power industry applications	Software business and data processing revenue	+
		Data openness	Data openness in Langfang	+

2.1.2 Dependent variable

Digital Transformation of Industries (IND), this paper adopts the approach of Yang Wenpu (2022) and sets the digital transformation of industries as a primary indicator. It constructs secondary indicators from three dimensions: digital infrastructure, industrial digital investment, and industrial digital output. Among these, the layout and construction of digital infrastructure in Langfang City form the foundation for the city's digital transformation of industries. This paper primarily selects the number of software companies and e-commerce companies in the urban districts and counties of Langfang to measure this aspect. In terms of industrial digital investment, greater investment intensity indicates that Langfang places more emphasis on the digital transformation of industries. The paper selects the annual growth rate of R&D funds for large-scale enterprises, computer service fees for large-scale enterprises, and information transmission fees for large-scale enterprises to measure this. The output of industrial digitalization mainly reflects the deep integration of digital technology into industries, enhancing economic, social, and ecological benefits. It directly demonstrates the contribution of the digital transformation of industries to Langfang's economic development. This paper primarily selects software industry revenue and e-commerce platform sales revenue as indicators to measure this aspect. For any missing values, they are estimated using the mean interpolation method. The specific indicator system for measuring Langfang's digital industrial transformation is shown in Table 2.

Table 2 Digital industrial transformation index system

Primary indicators	Secondary indicators	Indicator definitions	attribute
Industrial digital transformation	Digital infrastructure	Number of software companies	+
		Number of e-commerce enterprises	
	Industrial digitalization investment	Annual growth rate of scientific research expenditure of enterprises above designated size	+
		Computer service fee for enterprises above designated size	+
	Digital output of industry	Information transmission fee for enterprises above designated size	+
		Revenue from the software industry	

2.1.3 Control variables

To prevent other factors from affecting the digital transformation of industries, this paper selects the following control variables: Urbanization Rate (URB), measured by the ratio of urban population to permanent residents at the end of the year in Langfang; Industrial Structure (IND), measured by the proportion of output value from primary, secondary, and tertiary industries in Langfang's gross production; Technological Level (TEC), measured by the ratio of R&D expenditure to Langfang's gross production; Trade Openness (TRADE), measured by Langfang's trade dependence.

Table 3 Variable definition table

type of variable	Variable name	variable symbol
explanatory variable	Computing power development index	COMP
explained variable	Industrial digital transformation	DTI
controlled variable	Urbanization rate	URB
	industrial structure	IND
	scientific and technological level	TEC
	Trade openness	TRADE

2.2 Model construction

In order to test the impact of computing power development on the digital transformation of Langfang industry, this paper constructs the benchmark regression model as follows:

$$(1)COMP_{it} = \beta + \beta_1 DTI_{it} + \beta_2 \sum control_{it} + \varepsilon_{it}$$

In formula (1), represents the computing power $COMP_{it}DTI_{it}\varepsilon_{it}$development index of Langfang district i in year t; represents the industrial digitalization level of Langfang district i in year t; control represents a series of control variables; city represents the fixed effect of district and county; time represents the fixed effect of time; is the random disturbance term.

2.3 Data sources

This paper selects 184 large-scale enterprises in Langfang City from 2014 to 2024. The data are sourced from the "Langfang National Economy and Social Development Statistical Bulletin," "Langfang Statistical Yearbook," the website of the National Intellectual Property Administration, and the "China Comprehensive Computing Power Index (2024)." For missing data, interpolation methods were primarily used for supplementation, and all data were processed with logarithmic transformation.

Table 4 Descriptive statistical analysis results of variables

variable	crest value	least value	mean	standard error
COMP	25.221	0.000	0.771	0.642
DTI	0.1427	0.078	0.108	0.063
URB	0.681	0.572	0.670	0.481
IND	1.326	0.373	0.898	0.216
TEC	0.844	0.436	0.723	0.016
TRADE	0.156	0.143	0.151	0.130

3 Empirical analysis

3.1 Benchmark regression test

This paper conducts Hausman test on the development of computing power to enable the digital transformation of industries in Langfang city. The statistical value of the test results is greater than the critical value, so the fixed effect model is adopted. The test results are shown in Table 5.

Table 5 Results of benchmark regression test

variable	(1)	(2)	(3)
	DTI	DTI	DTI
COMP	0.083***	0.079***	0.077***
	(0.030)	(0.027)	(0.023)
URB		0.142**	0.128**
		(11.387)	(10.216)
IND		0.338	0.316
		(1.447)	(1.394)
TEC		1.474	1.372
		(0.312)	(0.298)
TRADE		0.337	0.293
		(0.112)	(0.098)
Individual fixed effects	deny	deny	yes
Time fixed effects	deny	deny	yes
observed value	184	184	184
R2	0.641	0.637	0.592

In Table 5, column (1) only examines the effect of core explanatory variables on the dependent variable. The regression coefficient of Langfang's computing power development on industrial digital transformation is 0.083, significant at the 1% level, indicating a positive effect of Langfang's computing power development level on its industrial digital transformation. Column (2) adds control variables to column (1), with the estimated coefficient of Langfang's industrial digitalization being 0.079, significant at the 5% level; column (3) adds individual fixed effects and time fixed effects to column (2), and the test results show that the estimated coefficient of Langfang's computing power development level on industrial digitalization is significantly positive at the 1% level, indicating a significant positive impact regardless of whether control variables are added, suggesting that Langfang's computing power development level can effectively empower its industrial digitalization, promoting the digital transformation of Langfang's industries.

3.2 Endogeneity test

The empirical analysis results show that the development of computing power can significantly promote the digital transformation of industries in Langfang. However, the development of computing power in Langfang will be influenced by the economic development levels and needs of its various counties and districts. Therefore, to avoid endogeneity issues, this paper employs instrumental variable methods, based on exogeneity and correlation, to select instrumental variables from a demand perspective. The primary tool variable used is the number of high-tech enterprises in each district and county of Langfang. The test results are shown in Table 6.

Table 6 Regression test results of tool variables

	stage Ⅰ	stage Ⅱ
COMP		0.037***
		(0.022)
instrumental variable	0.084***	0.076***
	(0.031)	(0.029)
URB	0.115**	0.108**
	(9.117)	(9.001)
IND	0.305	0.298
	(1.228)	(1.115)
TEC	1.284	1.131
	(0.287)	(0.276)
TRADE	0.279	0.254
	(0.085)	(0.075)
Individual fixed effects	yes	yes
Time fixed effects	yes	yes
observed value	184	184
R^2	0.527	0.505

As can be seen from Table 6, after considering the instrumental variables, the test coefficient of industrial digital transformation is still significant at the 1% level, and both LM value and F value are greater than their critical values, passing the weak instrumental variable test, that is, the number of high-tech enterprises in each district and county of Langfang city is used as the instrumental variable, which is effective, and the above benchmark regression results hold.

3.3 Robustness test

The indicators for measuring the development level of computing power in Langfang City constructed in this paper are based on the assumption that the development levels of computing power in different districts and counties of Langfang are basically the same. However, in actual development processes, due to different geographical locations, the economic development levels of various districts and counties in Langfang also vary. Therefore, the evaluation indicators for computing power may not accurately reflect the development levels of computing power in different districts and counties of Langfang, which could lead to biased test results. Thus, this paper will use the following methods to conduct robustness tests on the aforementioned benchmark regression results. First, replace the regression model. Since the economic development levels of different districts and counties in Langfang vary, they will have a certain impact on the overall development level of computing power in Langfang. Therefore, this paper uses a dynamic panel model to verify the aforementioned test results. Second, replace the instrumental variable method, which involves lagging the computing power development level by one period and performing least squares regression. Third, apply the truncation method, which reduces the impact of extreme data collected on the test results by truncating the computing power development level of Langfang by 2% above and below the mean. The test results of the above three methods are shown in Table 7.

Table 7 Robustness test

	(1)	(2)	(3)
	Replace the model	Replace the instrumental variable	Tail retraction
COMP	0.032***	0.030***	0.027***
	(0.021)	(0.021)	(0.019)
instrumental variable	0.081***	0.079***	0.074***
	(0.029)	(0.028)	(0.026)
URB	0.109**	0.110**	0.107**
	(8.496)	(8.652)	(8.361)
IND	0.342	0.331	0.319
	(1.114)	(1.008)	(1.003)
TEC	1.201	1.121	1.115
	(0.264)	(0.251)	(0.241)
TRADE	0.269	0.247	0.231
	(0.077)	(0.069)	(0.066)
Individual fixed effects	yes	yes	yes
Time fixed effects	yes	yes	yes
observed value	184	184	184
R^2	0.491	0.492	0.482

As can be seen from Table 7, after the three methods are processed, the impact effect of computing power development on the digital transformation of Langfang industry is still significant, indicating that the above benchmark regression results are robust.

4 Conclusions and policy recommendations

The development of computing power is a crucial measure to promote high-quality economic growth and is key to the development of new productive forces. This paper selects 184 large-scale enterprises in Langfang City from 2014 to 2024 as samples to conduct an in-depth study on the impact of computing power development on the digital transformation of Langfang's industries. The following conclusions were drawn: the development of computing power can effectively empower the digital transformation of Langfang's industries, and this conclusion remains robust after robustness tests. Based on these research findings, the following policy recommendations are proposed: First, at the government level, actively promote the construction of computing infrastructure. Relevant government departments should scientifically plan the layout of computing infrastructure from a top-level perspective, fully leveraging the guiding role of planning to enrich application scenarios for computing technology. Promote deep integration of computing with industries. Relevant government departments must fully understand and ensure effective supply of computing power during the process of industrial digital transformation, promoting the deep application of computing technology in enterprises. Second, at the enterprise level, enterprises should actively utilize computing resources and establish systems for applying computing technology, optimizing the allocation of computing resources. Actively recruit high-tech computing talent to ensure that enterprises have sufficient human capital for the application of computing technology.

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