

# Digital Transformation and Total Factor Productivity of Enterprises

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## Abstract

Digital transformation is not only a necessary path to promote enterprise transformation and upgrading, but also one of the key paths to bridge the digital divide and achieve sustainable development. This article is based on the data of listed companies in coastal areas of China from 2011 to 2022, constructs a digital transformation index, and, on the basis of alleviating endogeneity issues, empirically finds that digital transformation has a significant positive impact on total factor productivity of enterprises through a series of robustness tests. Among them, digital transformation mainly promotes the improvement of total factor productivity through various means such as expanding the path of enterprise innovation and development, effectively constructing human capital structure, and enhancing resource allocation efficiency. The research conclusion of this article provides data support and analytical perspective for the productivity effect of digital transformation, and also provides policy reference for expanding new paths.

## Keywords

Digital Transformation; Total Factor Productivity of Enterprises; Endogeneity Analysis; Robustness Testing; Innovation Driven.

## 1. Introduction

With the rapid development of the global digital economy, digital applications have penetrated into every aspect of people's production and life, attracting attention for their potential in innovation, value creation, and driving economic growth. The report of the 20th National Congress of the Communist Party of China emphasizes that high-quality development should be the primary goal, actively promote digital transformation, and enhance the level of scientific and technological innovation. In the context of the digital economy, data serves as the core driving force for digital transformation. Compared to the constraints of traditional factor markets, the use of data has broken through limitations, providing new opportunities and potential for economic development, and promoting the transformation of economic development from conventional to digital. Nowadays, digital transformation has become one of the important strategies for enterprises to improve total factor productivity and achieve sustainable development. The widespread application of digital technology has not only changed traditional business models, but also reshaped the production methods and organizational structure of enterprises. Specifically, digital transformation helps optimize organizational structure, improve production processes, enhance product and service quality, expand markets and customer groups, and ultimately achieve an increase in total factor productivity.

Total factor productivity, as an important indicator for measuring economic efficiency and resource utilization efficiency, is crucial for achieving sustainable economic development. To promote stable growth of total factor productivity, we must seize the opportunities of digital economy development, organize the use of digital technology to complete digital

transformation, and deeply explore the impact of digital economy on innovation efficiency, resource allocation, economic benefits, and other aspects. The improvement of total factor productivity can stimulate innovation vitality, improve resource utilization efficiency, achieve efficient social governance, and is an important guarantee for promoting high-quality economic growth.

## 2. Theoretical Analysis and Research Hypotheses

### 2.1. Hypothesis 1

Digital transformation broadens the path of enterprise innovation and development, thereby significantly promoting the total factor productivity of enterprises.

#### 2.1.1. Concrete Content

Firstly, digital transformation significantly promotes total factor productivity of enterprises by broadening their innovative development paths. By utilizing advanced information technology and first-class data analysis methods, we can help enterprises achieve multiple innovation modes, change their innovation system, provide better, more convenient, and personalized services, optimize management processes and employee productivity. These innovations help meet market demand, enhance customer stickiness, expand market share, and avoid resource waste. Firstly, digital transformation has improved the utilization efficiency of production factors and the intelligence level of production processes. Digital transformation, driven by data-driven operational management decisions, has changed the organizational form and management methods of enterprises, promoting innovative organizational models such as platformization, networking, and collaboration, and optimizing resource allocation. In addition, digital transformation has changed the innovation mode of enterprises. Traditionally, enterprise innovation mainly relies on independent research and exploration, while digital transformation promotes open innovation by collaborating with external enterprises, innovators, and communities, utilizing open data resources to innovate in a faster, more flexible, and diverse manner.

### 2.2. Hypothesis 2

Digital transformation can effectively construct organizational structure of enterprises to improve total factor productivity.

#### 2.2.1. Concrete Content

Secondly, digital transformation improves the total factor productivity of enterprises by effectively constructing organizational structures. Firstly, digital transformation has driven a transformation in talent cultivation and introduction. Enterprises need to cultivate employees with digital skills, data analysis abilities, and innovative thinking to meet the needs of the digital age. At the same time, enterprises also need to attract talents with relevant skills and experience to fill the technical and knowledge gap within the organization. By optimizing the talent structure, enterprises can better cope with the challenges brought by digital transformation, achieve more efficient production processes and information management. Secondly, digital transformation has changed the organization and communication methods of enterprises. The traditional vertical organizational form is being replaced by flat, networked, and collaborative organizational models. This new organizational form encourages collaboration, sharing, and innovation among employees, improving team efficiency and creativity. Through digital technology tools and collaborative platforms, employees can achieve cross regional and cross departmental cooperation, accelerate problem solving and decision-making processes, and improve the efficiency of production factor utilization. In addition, digital transformation has also promoted the sharing and learning of knowledge and information. Employees can acquire new knowledge and skills through online learning

platforms, social media, and internal knowledge bases, and apply them to their work. This continuous learning and innovation culture helps to improve the comprehensive quality and ability of employees, further promoting the total factor productivity of the enterprise.

### 2.3. Hypothesis 3

Digital transformation promotes enterprises by optimizing resource allocation efficiency and achieving cost rationalization total factor productivity of the industry.

#### 2.3.1. Concrete Content

Thirdly, digital transformation improves the total factor productivity of enterprises by optimizing resource allocation efficiency and achieving cost rationalization. Firstly, digital transformation can introduce automation and intelligence technologies to replace traditional labor-intensive work, gain a more accurate understanding of resource needs and utilization, thereby achieving more effective resource allocation, reducing labor costs, and reducing the risk of human errors. Secondly, digital transformation can leverage machine learning and artificial intelligence technologies to optimize supply chain management, achieve visualization of the supply chain, accurately predict and optimize resource demands, reduce inventory and logistics costs, avoid resource waste and shortages, and improve resource utilization efficiency. In addition, digital transformation can also provide better resource coordination and collaborative management. Through digital platforms and collaborative tools, enterprises can monitor and adjust resource allocation in real-time, making resource coordination between departments more efficient. Finally, digital transformation also optimizes human resource management, achieving personalized and refined recruitment, training, and performance evaluation, improving the efficiency and quality of human resources, reducing related costs, and improving the total factor productivity of enterprises.

## 3. Econometric Models and Variable Descriptions

### 3.1. Data Sources

This article selects listed companies in coastal areas of China from 2011 to 2022 as research samples, and the data sources include two parts: (1) collecting and organizing financial information of listed companies in coastal areas of China from 2011 to 2022 in the Guotai An database, and analyzing the index of their degree of digital transformation; (2) Calculate the average total factor productivity of listed companies in coastal areas for each year based on data from Wanfang Database and China Statistical Yearbook. In addition, to ensure the reliability of empirical results, the obtained data needs to be processed as follows: (1) excluding samples with abnormal or missing data, as well as excluding financial securities companies, ST or \* ST enterprises, and enterprises marked as delisted; (2) We also need to truncate continuous variables to remove the extreme values of 1% before and after.

Avoid affecting the robustness test results.

### 3.2. Model Settings

Based on the above theoretical analysis, this article sets the following model to specifically explore the impact of digital transformation on the total factor production of enterprises:

$$TFP_{it} = \beta_0 + \beta_1 Digital_{it-1} + \sum \varphi Control_{it-1} + Industry + Year + \varepsilon_{it-1}$$

Among them, the dependent variable TFP represents the total factor productivity of the enterprise, which is mainly measured through the LP method, and the specific calculation involves output, capital input, and labor input. The core explanatory variable Digital represents

the Digital Transformation Index, calculated from the indicator system constructed earlier. Control is a control variable at the enterprise level. To ensure the accuracy of the experimental results, this article selects multiple control variables for empirical testing.

## 4. Empirical Analysis

### 4.1. Benchmark Regression Results

The empirical results of the relationship between digital transformation and total factor productivity of enterprises are based on the relationship between digital transformation and total factor productivity of enterprises. The following conclusion can be drawn: In the absence of control variables, the Digital Transformation Index (Digital) has a significant positive promoting effect on total factor productivity of enterprises, with a coefficient of 0.096, and is statistically significant; When we added control variables, the coefficient of the Digital Transformation Index remained positive and significant, but the coefficient value decreased to 0.017. The above results further validate our theoretical hypothesis that digital transformation has a significant impact on the improvement of total factor productivity in enterprises.

### 4.2. Endogeneity Analysis

Based on the benchmark regression results mentioned above, we can find that the level of digital transformation can significantly promote the total factor productivity of enterprises, and there is a positive correlation between the two. However, some unobservable factors may play a complex regulatory role in it, and these potential factors may be overlooked by the model, leading to endogeneity issues. This article considers using instrumental variables related to digital transformation but not directly affecting the total factor productivity of enterprises, and estimates the impact of digital transformation on the total factor productivity of enterprises through instrumental variable regression. The results indicate that digital transformation has substantive significance in improving the total factor productivity of enterprises, and enterprises can achieve higher production efficiency and competitive advantages by actively promoting digital transformation.

### 4.3. Robustness Check

To verify the robustness between digital transformation and total factor productivity of enterprises, we considered controlling for multiple factors. Firstly, we used different subsets of sample data (such as different industries, regions, company sizes, etc.) to test whether the impact of digital transformation on total factor productivity of enterprises is universal. The results indicate that in different subsets, the impact of digital transformation on total factor productivity of enterprises is positive and significant. Secondly, considering that the sudden outbreak of the epidemic in 2020 may have an uncertain impact on variables such as total factor productivity and digital transformation index of enterprises, in order to ensure the rationality of robustness testing, we chose to remove the 2020 samples affected by the epidemic and conduct regression again. In addition, in the raw data section, we replaced the digital transformation index with the natural logarithm of the total frequency of digital transformation words and conducted a stability test. According to the test results, digital transformation has a positive and significant impact on the total factor productivity of enterprises, proving the validity of our hypothesis.

## 5. Conclusion

This article selects data from listed companies in coastal areas of China from 2011 to 2022. After theoretical analysis, alleviation of endogeneity issues, and robustness testing, we can draw the following conclusion: (1) Overall, digital transformation can significantly improve the

total factor productivity of enterprises. (2) Digital transformation mainly promotes the improvement of total factor productivity of enterprises by broadening their innovation paths, effectively constructing human capital structures, and improving resource allocation efficiency.

Based on the above conclusions, this article proposes the following policy recommendations:

Firstly, optimize the policy environment, improve a series of institutional mechanisms and policies, and lay the foundation for enterprises to implement digital transformation. The government can formulate relevant policies and regulations, including providing financial incentives, establishing data privacy protection and information security regulations, to reduce the cost of digital transformation for enterprises and ensure their safe and sustainable development. In addition, the government can reform by promoting government transparency and transparency, strengthening policy coordination and integration, and establishing a digital transformation regulatory mechanism to provide support and guidance for enterprises in digital transformation, in order to promote digital transformation towards sustainable development. At the same time, the government can reduce regulatory restrictions, create a better environment for the development of the digital industry, attract more enterprises to actively participate in digital transformation and total factor production, promote economic innovation and growth, create a better environment for the development of the digital industry, and improve total factor productivity by reforming the administrative approval system, reforming industrial policies, and market access.

Secondly, enterprises should fully leverage the role of resource allocation in digital transformation to achieve optimal efficiency and sustained competitiveness. By evaluating and optimizing the utilization of existing resources, introducing new digital technologies and tools, achieving digitalization and intelligence of business activities, greatly improving labor productivity, and reducing operating costs. By vigorously developing digital technology, enterprises can establish a centralized resource management platform, optimize internal processes and allocate resources more efficiently, avoiding duplicate procurement and waste. In addition, by strengthening collaboration with partners, enterprises can improve resource allocation efficiency and achieve higher competitiveness and sustainable development in the process of digital transformation.

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