



# An Empirical Analysis of the Impact of Digital Economy on Enterprise Technological Innovation

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**Abstract.** The inter-provincial panel data of China from 2015 to 2019 is used as the data source of this paper. Firstly, a comprehensive evaluation index system of digital economy is established, then the comprehensive development level of digital economy is calculated by entropy method. Secondly, this paper empirically studies the impact of digital economy on enterprise technological innovation by constructing a benchmark linear regression model. The conclusion of the study is that the digital economy can help enterprises improve the level of technological innovation, the scale of enterprises and the economic situation of enterprises have an impact on the ability of technological innovation. Based on this, it is proposed to continuously optimize the infrastructure, improve the governance system of the digital economy and accelerate the digital transformation of enterprises.

**Keywords:** Digital Economy · Technological Innovation · Empirical Test

## 1 Introduction and Literature Review

The digital economy plays an important role in industrial upgrading with the characteristics of rapid development and wide coverage. China's "Digital Economy Development Plan" proposes that the primary driving force for development is innovation, speed up the digital transformation of enterprise R & D and design, implement special actions for enterprise digital empowerment, vigorously enhance the independent innovation ability of enterprise digital technology, improve the transformation ability of enterprise innovation achievements, accelerate the industrialization and application of innovative technology. In general, the digital economy can reduce corporate financial pressure and operating costs, and enterprises can understand the innovation needs of the market according to digital information technology.

The research on digital economy is more about its influence. Xing, L., and Cai, X.L. (2020) proved that the digital economy is helpful to promote technological innovation and product innovation, and the influencing factors also include capital investment, talent investment and public digital literacy [1]. Du, C.Z., and Zhang, Y. (2021) believed that the improvement of enterprise productivity is affected by the digital economy, and the growth of enterprise productivity benefits from the improvement of technological innovation

ability [2]. Shen, M.H. et al. (2022) believed that the integration of the digital economy makes the problem of insufficient resources of innovative talents in enterprises can be solved through two ways: high-end talent aggregation effect and reducing environmental uncertainty [3].

The research on enterprise technological innovation is mainly about the influencing factors of enterprise technological innovation. Taking private technology enterprises as a case study, Shang, H.T., and Fang, D. (2021) found that government subsidies promote technological innovation by improving the risk-taking ability of enterprises, and there is a lag incentive effect [4]. Xie, X.Y., and Zhu, X.Y. (2021) proved that the integration of digital finance is of great help to the technological innovation ability of SMEs through theoretical and empirical research [5]. Yu, F.F., and Wang, L.T. (2022) used the case study method to define the connotation of digital technology empowering manufacturing technology innovation, and proposed a model of digital technology empowering manufacturing technology innovation [6].

Therefore, based on previous studies, using China's inter-provincial panel data from 2015 to 2019 to empirically test the impact of the digital economy on corporate technological innovation.

## 2 Forward Hypothesis

Digital economy can effectively reduce the operating costs of enterprises. First of all, the organizational structure of traditional enterprises has been changed due to new business models and digital technologies, reduced the operating and management costs of enterprises, timely solved the asymmetry of enterprise information, and then improved the efficiency of enterprises to transform knowledge into innovative achievements [7]. Secondly, the application of digital information technology makes the enterprise production process more optimized, alleviates the financial pressure of enterprise technological innovation, and the digital economy can alleviate the difficulty of enterprise innovation financing by broadening the financing channels of enterprises [8].

The integration of digital economy will stimulate the innovation power of enterprises. The widespread use of the digital information era has replaced the original enterprise-led innovation R & D model with the innovation model of direct interaction between enterprises and consumers. The new requirements triggered by the digital economy will continue to stimulate the innovation and R & D power of enterprises. According to the feedback of consumer information, enterprises will continue to develop and innovate new products. In addition, the rapid development of the digital economy has higher requirements for enterprise innovation capabilities, the industry barriers between enterprises will be declining, the innovation cooperation between enterprises will continue to increase, and the new market competition will encourage enterprises to continuously strengthen their technological innovation capabilities [9].

Based on the analysis of the above two points, the research hypothesis of this paper is put forward: digital economy can improve the technological innovation ability of enterprises.

### 3 Research Design

#### 3.1 Data Sources

The panel data of 30 provinces in China from 2015 to 2019 are used as the data source of this paper (Tibet Autonomous Region is not included due to serious lack of data).

#### 3.2 Variable Selection

Core explanatory variable: digital economy. The index system is constructed from three aspects to reflect the development level of digital economy, as shown in Table 1. Then the comprehensive development level of digital economy is calculated by entropy method [10].

Explained variable: enterprise technology innovation. The amount of invention patent application authorization can not only reflect the effectiveness of enterprise technological innovation, but also reflect the technological achievements of enterprise research and development. Therefore, the amount of invention patent application authorization is selected to characterize enterprise technological innovation.

Control variables: including enterprise level and provincial level. The enterprise level includes: enterprise scale, asset-liability ratio, return on assets. The provincial level includes: economic development level (per capita GDP).

**Table 1.** Comprehensive Evaluation Index of Digital Economy

First-order Index	Secondary Index	Three-level Index	Unit
Digital Economy	Infrastructure	Number of Broadband Internet Access	Thousand Households
		Information Software Employees	Ten Thousand
	Digital Industrialization	Total Amount of the Telecommunication Service	Billion Yuan
		Number of Electronic Information Manufacturing Enterprises	Thousand
		Software Business Income	Billion Yuan
	Industrial Digitalization	Enterprises Introduce Technology Funds	Million Yuan
		Enterprise Technical Transformation Expenditure	Million Yuan
		E-commerce Sales	Billion Yuan

### 3.3 Model Construction

In order to test the impact of digital economy on enterprise technology innovation, this paper constructs the following model:

$$Y_{it} = \beta_0 + \beta_1 Dig_{it} + \beta_2 Con_{it} + \theta_t + \varepsilon_{it} \tag{1}$$

Among them, Y is the enterprise innovation, Dig is the digital economy, Con indicates the control variables,  $\theta_t$  is the time fixed effect,  $\varepsilon_{it}$  is random disturbance term, i is province, t is year.

## 4 Empirical Analysis

### 4.1 Baseline Regression Analysis

The fixed effect model was used to analyze the data, and Table 2 shows the analysis results. Column (1) shows the regression results of digital economy on enterprise technology innovation, the regression coefficient of the digital economy is 0.2 and significant at the 1% statistical level, and the regression coefficient shows that digital economy can improve the technological innovation ability of enterprises. Column (2) represents the test results after adding control variables, and the regression coefficient of digital economy is 0.13, which is still positive and significant at the 1% level. In summary, the hypothesis of this paper is established.

**Table 2.** Regression Results

Variable	(1) Technological Innovation	(2) Technological Innovation
Digital Economy	0.2*** (0.014)	0.13*** (0.01)
Economic Development Level		0.24** (0.12)
Enterprise Scale		0.32*** (0.03)
Asset-Liability Ratio		1.92*** (0.55)
Return on Assets		-0.27 (0.75)
Constant Term	0.27	-1.85
$R^2$	0.93	0.82

Note: \*, \*\*, \*\*\* represent significant at the statistical level of 10%, 5% and 1%, respectively, and the values in brackets are standard errors, the same below

**Table 3.** Robustness Test

Variable	(1)	(2)
Digital Economy	0.13*** (0.01)	0.16*** (0.02)
Economic Development Level	0.24** (0.12)	0.25** (0.13)
Enterprise Scale	0.32*** (0.03)	0.18*** (0.07)
Asset-Liability Ratio	1.92*** (0.55)	1.07* (0.58)
Return on Assets	-0.29 (0.75)	0.30 (0.36)
Constant Term	-1.9	-0.96
$R^2$	0.82	0.89

## 4.2 Stability Test

Robustness tests were conducted using alternative explained variables and alternative measurement methods respectively. Firstly, enterprise technology innovation is represented by the proportion of enterprise R & D expenditure to assets of enterprises. Secondly, the measurement method is changed, and the random effect model is used for regression test. The regression coefficients obtained by the two tests are shown in columns (1) and (2) of Table 3. The coefficients of the digital economy are 0.13 and 0.16 respectively, which are still significantly positively correlated. The results of these two analyses are consistent with those of the previous fixed effects analysis, indicating that this paper has passed the robustness test.

## 5 Conclusions and Policy Recommendations

### 5.1 Conclusion

The inter-provincial panel data of China from 2015 to 2019 is used as the data source of this paper. Firstly, a comprehensive evaluation index system of digital economy is established, then the comprehensive development level of digital economy is calculated by entropy method. Secondly, this paper empirically studies the impact of digital economy on enterprise technological innovation by constructing a benchmark linear regression model. The conclusion of the study is that the digital economy can help enterprises improve the level of technological innovation, the scale of enterprises and the economic situation of enterprises have an impact on the ability of technological innovation.

### 5.2 Policy Recommendations

Through the empirical results of this paper, the following policy implications are obtained. First, constantly optimize infrastructure construction. Guide enterprises to

accelerate the construction of 5G and optical fiber networks, promote the large-scale application of 5G networks, expand the scope of use of network infrastructure, and upgrade the relatively backward digital technology infrastructure. Build regional data center clusters, and speed up the construction of network information security facilities. Second, accelerate the digital transformation and upgrading of enterprises. Provide good guarantee for enterprise digital development, construct a practical policy support system according to the current situation of enterprise development. Promote the intelligent transformation and digital construction of enterprises, and actively carry out digital platform construction. Third, improve the governance system of the digital economy. Supplement the relevant legal provisions of the digital economy, create a fair digital business environment, and effectively protect the legitimate rights and interests of enterprises.

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(3) Research on the construction of new business talent training system and the evaluation of talent training quality (SJGZ20190025).

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