

The Impact of Digital Technology on Enterprise Operational Performance

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Abstract. This study focuses on the impact of digital technologies—such as big data, artificial intelligence (AI), and cloud computing—on enterprise operational performance against the backdrop of the accelerating penetration of the digital economy. Using listed companies in the Shanghai and Shenzhen stock exchanges from 2010 to 2025 as the sample, this paper employs a fixed effects model to empirically examine the mechanisms through which digital technology applications affect operational performance. The findings reveal that the overall application of digital technologies significantly enhances business performance by optimizing resource allocation and empowering business innovation, thereby improving operational efficiency. However, in the short term, the standalone application of cloud computing or artificial intelligence may suppress performance, highlighting the challenges of transformation costs and adaptation difficulties. The influence of digital technologies on enterprise operational performance is complex: while a significant positive effect and implementation pathway exist, challenges persist in the short-term application of individual technologies.

Keywords: Digital Technology, Enterprise Operational Performance, Digital Transformation

1. Introduction

1.1. Research background

With the rapid development of the digital economy, digital technologies such as big data, artificial intelligence (AI), and cloud computing have become key drivers of enterprise operational performance. The application of digital technologies not only significantly enhances operational efficiency, customer experience, and market competitiveness, but also creates new opportunities for business growth. Through big data analytics, enterprises can accurately identify market demands, optimize supply chain management, and reduce operational costs, thereby achieving efficient resource allocation. At the same time, the adoption of digital technologies is increasingly widespread among small and medium-sized enterprises (SMEs). In particular, among “specialized, refined, distinctive, and innovative” (SRDI) enterprises, digital technology has become a vital tool for enhancing innovation capabilities and optimizing resource allocation. By leveraging digital tools, these enterprises are better able to respond to market changes and strengthen their core competitiveness.

However, despite the promising prospects of digital technology adoption, enterprises still face numerous challenges during the process of digital transformation. Data security concerns are becoming increasingly prominent. While enjoying the benefits of digitalization, enterprises are also exposed to risks such as data breaches and cyberattacks. These challenges not only pose potential threats to the effectiveness of digital transformation but may also introduce uncertainties into enterprise operational performance.

1.2. Research significance

Studying the impact of digital technologies on enterprise operational performance carries significant theoretical and practical implications. From a theoretical perspective, this research enriches the theoretical framework linking digital transformation and enterprise performance. Existing studies have shown that digital technologies enhance enterprise performance through mechanisms such as data integration and process coordination [1]. In the context of renewable energy enterprises, digital transformation promotes financial performance through the full mediating effect of green technological innovation [2]. These findings help address the limitations of traditional theories in explaining the heterogeneity of technological pathways and provide a foundation for constructing a systematic “technology–performance” model.

From a practical standpoint, this study offers a scientific basis for enterprises to formulate digital transformation strategies. The research findings can assist enterprises in comparatively analyzing the impact of various digital technologies—such as cloud computing, big data, and artificial intelligence—on operational performance, thereby enabling optimized technology investment decisions and more efficient resource allocation.

The widespread adoption of digital technologies is profoundly reshaping enterprise operations and the broader socioeconomic structure. At the enterprise level, digital technologies optimize production processes and improve operational efficiency, thereby enhancing competitiveness. At the industrial level, the application of digital technologies fosters collaborative innovation across upstream and downstream segments of the industrial chain, driving structural optimization and industrial upgrading. Therefore, investigating the impact of digital technologies on enterprise operational performance not only contributes to business development but also supports the high-quality development of the broader economy, endowing this research with substantial practical significance and strategic value.

2. Literature review

2.1. Literature review on digital technology

Digital technology is commonly defined as a new generation of technologies encompassing social media, cloud computing, analytics, mobile technologies, and the Internet of Things (IoT) [3], including big data, cloud computing, and embedded devices.

In the economic domain, digital innovation has enhanced productivity and reduced costs by transforming industrial structures. In agriculture, digital technologies have contributed to increased rural income by mitigating urban-rural disparities, supporting entrepreneurial activity among farmers, and improving rural human capital. In the healthcare sector, digitally empowered service reconstruction has become a key approach to bridging service gaps, mainly through the redesign of service structures, delivery mechanisms, and interactive processes. In the education sector, digital technologies have, to some extent, addressed shortcomings in traditional classroom teaching. In the

tourism industry, new tourism formats—such as online travel platforms and virtual reality experience centers—are continually emerging, offering visitors an unprecedented sensory experience [4].

2.2. Literature review on enterprise operational performance

In studies examining the impact of innovation on the performance of cross-border e-commerce enterprises, different types of innovation have been found to play distinct roles. From the perspective of technological innovation, innovation in key core technologies enhances enterprise performance by improving production and operational efficiency as well as market profitability [5]. From the perspective of green innovation, implementing a green innovation strategy can sustainably enhance business performance, and this relationship is moderated by factors such as enterprise size and national context [6].

Research on the relationship between corporate culture and enterprise performance has shown a multidimensional developmental trajectory. Early studies suggested that corporate culture can enhance organizational efficiency by strengthening internal coordination and control, thereby positively influencing enterprise performance [7]. Barney, J. B. further argued that if a corporate culture possesses uniqueness, irreplaceability, and value, it can generate sustainable competitive advantages and lead to strong financial performance [8]. However, the relationship between corporate culture and enterprise performance is not always positive; certain aspects of corporate culture are sometimes viewed as unnecessary expenditures, thereby negatively affecting firm value.

The mechanisms by which supply chain networks affect enterprise performance are also multidimensional. From a structural perspective, digitalization promotes the transformation of supply chains into ecosystems, with network synergy effects creating new value-enhancement opportunities [9]. From a financial perspective, supply chain finance expands profit channels but may also have adverse impacts on upstream enterprises and the industry as a whole [10]. These mechanisms intertwine, giving rise to a "double-edged sword" effect of the supply chain on enterprise performance—the ultimate outcome depending on the dynamic balance among these forces.

2.3. Literature review on the impact of digital technology on enterprise operational performance

Digital technologies significantly enhance enterprise operational performance through multiple pathways, including optimizing operational processes, promoting collaborative innovation, and enabling intelligent decision-making. Studies have shown that digital transformation—such as the adoption of AI and cloud computing—can significantly improve enterprise performance by optimizing resource allocation and automating processes [11]. At the same time, by accurately matching market demand and enhancing supply chain agility, digital technologies not only improve operational efficiency but also empower enterprises to process market data more effectively, strengthen decision-making efficiency, and enhance responsiveness to market changes, ultimately boosting profitability.

At the level of specific technological applications, AI technologies can provide deep insights into customer behavior and market trends, thereby optimizing marketing strategies and supply chain management, and improving overall operational performance [12]. Moreover, the application of AI significantly enhances enterprises' customer agility and absorptive capacity [13]. In addition,

blockchain technology enhances supply chain agility, adaptability, and coordination through mechanisms of trust, thereby optimizing enterprise performance [14].

However, while digital technologies bring new opportunities, they are also accompanied by new challenges. Digitalization can give rise to risks associated with global digital connectivity and increased regulatory complexity, which enterprises must manage carefully during internationalization. Furthermore, the digital transformation process entails high learning costs and derivative management expenses, which can severely weaken the positive effect of digital technologies on enterprise performance [15]. Additionally, the open accessibility of digital technologies may expose enterprises to risks such as piracy and data security breaches, threatening competitive advantages and adversely affecting operational performance. Based on the above, this study proposes the following hypothesis:

Hypothesis 1: The application of digital technologies by enterprises contributes to improved business performance.

3. Research design

3.1. Model specification

This study selects panel data of listed companies on the Shanghai and Shenzhen stock exchanges from 2010 to 2025 for empirical analysis. A fixed effects model is employed to examine the impact of emerging digital technologies on enterprise operational performance. Drawing on the research of scholars such as He X. J., the econometric model is constructed as follows:

$$Oep_{it} = \alpha_0 + \alpha_1 digital_index_{it} + \alpha_2 Controls_{it} + \alpha_3 Year_{it} + \alpha_4 Firm_{it} + \varepsilon_{it} \quad (1)$$

Where: *Oep* denotes enterprise operational performance; *digital_index* represents the composite application of digital technologies, calculated as $digital_index = \ln(1 + digital_freq + cloud_freq + bigdata_freq + ai_freq)$, and covers the usage frequency of digital technologies, cloud computing, big data, and artificial intelligence. The model also incorporates a set of control variables (*Controls*), as well as year (*Year*) and firm (*Firm*) fixed effects, to account for the influence of potential exogenous variables. The random disturbance term is denoted by ε ; subscripts *i* and *t* represent different firms and observation years, respectively.

3.2. Variable selection

Based on the CSMAR database, this study constructs an index to measure the level of enterprise digital technology adoption, systematically assessing firms' applications of digital technologies such as big data, cloud computing, and artificial intelligence. Enterprise operational performance is set as the dependent variable and is comprehensively measured using return on assets (ROA) and return on equity (ROE). ROA reflects a firm's ability to generate profit from its total assets and serves as an indicator of overall operational efficiency, while ROE focuses on the return to shareholders' equity, thereby revealing the actual effectiveness of capital utilization.

To effectively control for the influence of other factors on business performance, this study selects key control variables including the proportion of independent directors, board size, and asset-liability ratio. The inclusion of these control variables enables a more accurate assessment of the true effect of digital technology adoption on enterprise operational performance.

To ensure the scientific rigor and validity of the research conclusions, the following steps were taken during the sample selection process: First, enterprises in the financial industry and public utilities sector were excluded, in consideration of industry-specific characteristics. Second, only firms with complete financial records spanning five years or more were retained. Third, listed companies under special treatment (ST) were filtered out. Fourth, samples with missing data were removed. In the data processing stage, continuous variables were subjected to two-sided winsorization at the 1% percentile level to control for estimation bias caused by extreme values. Following the above procedures, a total of 46,284 valid observations were retained for analysis.

3.3. Data sources

This study selects A-share listed companies on the Shanghai and Shenzhen stock exchanges as the research sample, covering the period from 2010 to 2025. All fundamental data are sourced from the China Stock Market & Accounting Research (CSMAR) database.

Table 1. Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
ROA	55235	0.049	0.072	-0.24	0.262
ROE	55113	0.076	0.144	-0.7	0.42
LEV	55235	0.412	0.202	0.053	0.896
IndependentDirectorN	46466	0.377	0.053	0.333	0.571
DirectorN	46466	2.113	0.198	1.609	2.639
WordFrequency	27738	7.816	19.274	1	411
digital index	55237	.753	1.01	0	6.021
digitalfreq	55237	1.765	9.128	0	411
cloudfreq	55237	1.067	8.135	0	381
bigdatafreq	55237	0.616	6.065	0	283
aifreq	55237	0.473	5.107	0	287

4. Empirical results and analysis

4.1. Correlation analysis

Table 2. ROA correlations

Variables	ROA	digital_index	digital_freq	cloud_freq	bigdata_freq	ai_freq
ROA	1.000					
digital_index	-0.128* (0.000)	1.000				
digital_freq	-0.029* (0.000)	0.441* (0.000)	1.000			
cloud_freq	-0.037* (0.000)	0.362* (0.000)	-0.025* (0.000)	1.000		
bigdata_freq	-0.035* (0.000)	0.259* (0.000)	-0.020* (0.000)	-0.013* (0.002)	1.000	
ai_freq	-0.048* (0.000)	0.231* (0.000)	-0.018* (0.000)	-0.012* (0.004)	-0.009* (0.027)	1.000

*** p<0.01, ** p<0.05, * p<0.1

Table 3. ROE correlations

Variables	ROE	digital_index	digital_freq	cloud_freq	bigdata_freq	ai_freq
ROE	1.000					
digital_index	-0.120* (0.000)	1.000				
digital_freq	-0.028* (0.000)	0.441* (0.000)	1.000			
cloud_freq	-0.037* (0.000)	0.362* (0.000)	-0.025* (0.000)	1.000		
bigdata_freq	-0.036* (0.000)	0.259* (0.000)	-0.020* (0.000)	-0.013* (0.002)	1.000	
ai_freq	-0.042* (0.000)	0.231* (0.000)	-0.018* (0.000)	-0.012* (0.004)	-0.009* (0.027)	1.000

*** p<0.01, ** p<0.05, * p<0.1

The correlation results indicate a negative relationship between the application of digital technologies and enterprise financial performance. The correlation coefficients between the composite digital technology index (digital_index) and ROA and ROE are -0.128 and -0.120, respectively, both significant at the 1% level. Furthermore, increases in the usage frequency of digital technologies—including digitalization, cloud computing, big data, and artificial intelligence—tend to be associated with declines in ROA and ROE. This suggests that, in the short term, the

adoption of digital technologies by enterprises may have a certain negative impact on their financial performance. However, correlation analysis does not account for the influence of other factors such as the asset-liability ratio on ROA and ROE; therefore, empirical analysis results are more persuasive.

4.2. Baseline regression

Table 4. Baseline regression results

VARIABLES	ROA	ROE
digital_index	0.199*** (0.0608)	0.469*** (0.136)
digital_freq	-0.00755 (0.00560)	-0.0180 (0.0115)
cloud_freq	-0.0156** (0.00613)	-0.0275** (0.0120)
bigdata_freq	-0.00883 (0.00541)	-0.0179 (0.0121)
ai_freq	-0.0311*** (0.00989)	-0.0411** (0.0195)
LEV	-12.43*** (0.395)	-23.25*** (1.115)
IndependentDirectorN	-0.415 (1.241)	-2.289 (2.876)
DirectorN	1.129*** (0.385)	1.574 (0.977)
Constant	6.449*** (1.131)	12.09*** (2.831)
Observations	46378	46284
R-squared	0.492	0.371

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The empirical results indicate that the comprehensive application of digital technologies has a significant positive impact on enterprise operational performance. The baseline regression results show that digital_index is significantly positively correlated with both ROA and ROE at the 1% statistical significance level, indicating that the overall application of digital technologies can effectively enhance a firm's profitability and return on equity.

From the perspective of the underlying mechanism, the deep application of digital technologies may directly improve asset utilization efficiency—such as through precise supply-demand matching and inventory cost reduction—thereby driving growth in ROA. At the same time, business model innovation empowered by digitalization (e.g., integration of online and offline channels, data-driven

customer management) and improved decision-making efficiency can strengthen a firm's ability to generate profits, leading to a significant improvement in ROE.

5. Conclusion

This paper systematically reviews the relevant literature on digital technologies and enterprise operational performance, highlighting that digital technologies such as big data, cloud computing, and artificial intelligence have been widely applied across multiple fields, significantly enhancing enterprise operational efficiency. At the same time, the paper focuses on exploring the impact of digital technologies on enterprise operational performance and the challenges enterprises face during the transformation process.

Using data from listed companies on the Shanghai and Shenzhen stock exchanges, this study employs a fixed effects model to empirically test the influence of digital technologies on enterprise operational performance. The results show that the comprehensive application of digital technologies significantly improves enterprises' ROA and ROE, while the standalone application of certain technologies such as cloud computing and artificial intelligence may suppress performance in the short term.

This research enriches the theoretical framework of digital transformation and enterprise performance, providing a scientific basis for enterprises to formulate digital transformation strategies. By comparatively analyzing the effects of different digital technologies on operational performance, enterprises can optimize technology investment decisions and achieve efficient resource allocation.

Future research can further investigate the impact of emerging digital technologies such as blockchain and the Internet of Things (IoT) on enterprise operational performance, as well as extend the study to enterprises of different sizes and industries. Additionally, a deeper exploration of the specific pathways through which digital technologies affect enterprise operational performance will offer more concrete policy recommendations and strategic guidance, helping enterprises address transformation challenges and achieve high-quality development.

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