IT Investment and Corporate Performance: Moderating Effects of Regional Digitization

Meiyi Song
School of Accounting, Xijing University, Xi'an 710123, Shaanxi, China
Corresponding author: Meiyi Song (e-mail: songmy0406@163.com)

ABSTRACT Using Chinese listed companies as samples, this study empirically examines the influence of regional digital economy development on the relationship between information technology investment and corporate performance. Based on resource-based theory and core competence theory, the study uses data from all Chinese listed companies from 2016 to 2023 to analyze how information technology investment affects firm performance under different regional digitalization levels. Corporate performance is measured by Tobin's Q and return on assets. The results show that information technology investment generally has a positive effect on corporate performance, while the relationship exhibits an inverted U-shaped pattern consistent with diminishing marginal returns. Regional digitalization further moderates this relationship through the mechanism of digital knowledge spillover. The moderating effect is more pronounced in the eastern region, where digital infrastructure and digital capability are stronger, than in the western region. To address endogeneity, regression models and fixed-effects models are adopted, and robustness tests are conducted by replacing dependent variables and using lagged explanatory variables.

INDEX TERMS information technology investment, corporate performance, regional digitalization, digital knowledge spillover, fixed effects model

I. INTRODUCTION

INFORMATION technology (IT) originated in the United States and has since become an indispensable component of global social and economic development. China started adopting IT in the early 1980s, and as economic globalization deepened, the dissemination and application of IT accelerated, leading to increased investment. IT not only enhances enterprises' competitive advantages but also significantly impacts their performance, reshaping the competitive landscape through the continuous emergence of modern technologies, a transformation vividly reflected in the industry where digitalization is breaking down boundaries between design, manufacturing, and retail, fundamentally altering market dynamics [1]. Today, IT has become a critical strategic resource for enterprise development, prompting companies to formulate information strategies, accelerate informatization initiatives, and optimize management systems. This paper primarily analyzes the challenges in enterprise informatization and proposes corresponding countermeasures [2]. We also address a key theoretical gap by testing the fundamental economic expectation of diminishing marginal returns, thereby investigating a nonlinear, specifically an inverted U-shaped, relationship between IT investment and firm performance, which may vary depending on the regional digital environment. The concept of "digitization" was first introduced in Negroponte's 1996 book "Being Digital," where it was described as the process of converting analog information into digital form. Due to its characteristics of low communication costs, low replication costs, and the removal of time and space constraints, digitization has been widely integrated into various fields. Currently, the economic impact of digitization is a focal point of research among both domestic and international scholars [3]. In recent years, the digital economy has emerged as a key topic in global political economy conferences. Digitalization promotes the development of enterprises and participates in all aspects of enterprise production and operation, resulting in the use of digital management systems such as ERP and MES. Avi & Catherine [4] With advancements in IT, hot topics such as big data, cloud computing, AI, and other IT-related areas have gained significant attention. Digitization is increasingly recognized and valued by people, posing new challenges to societal transformation. Digital-driven entrepreneurship has become a central focus of digital economy strategies in many countries. Employing relevant theories, this study empirically analyzes the moderating effect of regional digitalization levels and offers recommendations designed to assist enterprises in improving performance. This offers valuable guidance to the industry on how to strategically leverage regional digital infrastructure to max-

imize the performance gains from their own investments in smart manufacturing. A critical yet unexamined aspect of this moderation is the mechanism through which regional digitalization enhances performance. We hypothesize that a higher regional digitalization level fosters a fertile ground for "digital knowledge spillover," leading to lower transaction costs, quicker access to digitally skilled talent, and the rapid assimilation of new digital business models among local enterprises. This external spillover effect maximizes the returns on a firm's internal IT investment.

II. LITERATURE REVIEW AND THEORETICAL

A. GENERAL OVERVIEW OF CHINA'S DIGITAL LEVEL DEVELOPMENT

In the past few years, the development of digitalization, networking and information technology in China has entered a new stage. With the weakening of the demographic dividend of the Internet and the penetration rate of mobile Internet approaching saturation, the digital development model has begun to show obvious changes. Growth on the consumer side is stabilizing, and a large number of new opportunities are emerging on the industrial side. The main battlefield of digital development is shifting from consumer Internet to industrial Internet. China's digitalization process has shifted from consumer Internet to industrial Internet. Industrial Internet is the most dynamic and potential field in the recent round of digitalization process and has entered the golden stage of development.

According to the Digital China Development Report on 2023 released by the China Data Bureau and relevant departments, the digital China index is divided into four sectors: digital industry, digital culture, digital life and digital government affairs, and the four sectors are closely linked to industry, consumption and government affairs, which are closely related to digital development. Based on the analysis of the digital development trend of 31 provinces, autonomous regions, municipalities directly under the Central Government and 351 cities in China, the proportion of China's digital economy will continue to increase in 2023, and the added value of core industries of the digital economy will exceed 12 trillion yuan, accounting for about 10% of GDP. The growth rate of China's digitalization related index shows a phenomenon of fast growth in the east and slow growth in the west, and the relative growth rate in the north and south is the same, and there is an obvious cluster effect. The contribution of related IT to digital China is further prominent. Cloud computing, as the core technology of IT development in recent years, has made great contributions to digital development. According to relevant data, GDP can be increased by more than 23 billion yuan for every 1 point increase in cloud cover. As an important infrastructure in the digital era, cloud computing will help all walks of life build basic capabilities for digital transformation. Cloud computing-related IT benefits are rapidly extending to central and western regions, demonstrating a strong correlation with the development of the digital economy. However, this trend has also exacerbated regional imbalances in digital development to some extent. Large urban agglomerations play a significant role in driving digital advancement. According to an analysis of specific indicators, among the 31 provinces, autonomous regions, and municipalities directly under the Central Government, Beijing, Guangdong, and Shanghai rank in the top three positions. The digital development levels of these administrative regions can be categorized into three tiers. The development model of China's digital level is shown in Table 1:

TABLE 1. China's digital level development pattern

China's digital level development pattern	Regions
First tier	Beijing, Guangdong, Shanghai, Jiangsu, Zhejiang, Shandong, Sichuan, Tianjin, Fujian, Hubei
Second tier	Henan, Chongqing, Hebei, Guizhou, Jiangxi, Anhui, Hunan, Liaoning, Shanxi, Guangxi, Yunnan, Shaanxi
Third tier	Inner Mongolia, Xinjiang, Heilongjiang, Jilin, Gansu, Hainan, Qinghai, Ningxia

According to the Digital China Index, in recent years the western region has exhibited the highest growth rate. However, this does not alter the overarching trend of rapid development in the east and relatively slower progress in the west. While the eastern region demonstrates superior overall development, the index growth rates confirm that the eastern region's advancement surpasses that of the western region. Specifically, the estimated growth rates for the total index were 84.64 percent in the eastern region, 79.69 percent in the central region, and 68.88 percent in the western region. The growth rates in the eastern and central regions are closely aligned and significantly exceed that of the western region. Consequently, the digitization index growth rate in the western region lags behind those in the eastern and central regions. The growth rate of the China Index by region is shown in Figure 1:

Li et al [5]. pointed out that the sustainable success of an organization is closely related to its dependence on and utilization of external resources, especially in the digital era, where enterprises not only rely on internal technologies and talents, but also integrate with the surrounding digital ecosystem. The quality of regional digital infrastructure, the popularization of information network and the level of intelligence become the key to shaping the digital experience of enterprises. These elements not only support the operation of digital technologies, but also create more possibilities for enterprises to connect with customers, suppliers and other stakeholders. Katz and Cakkirda [6] emphasized that regional digital infrastructure is the basic element of regional digitalization level, which has a decisive impact on the future development of enterprises. With the rapid development of digital technology, the digital level of the region continues to improve, providing convenient infrastructure and efficient communication platform for enterprises.

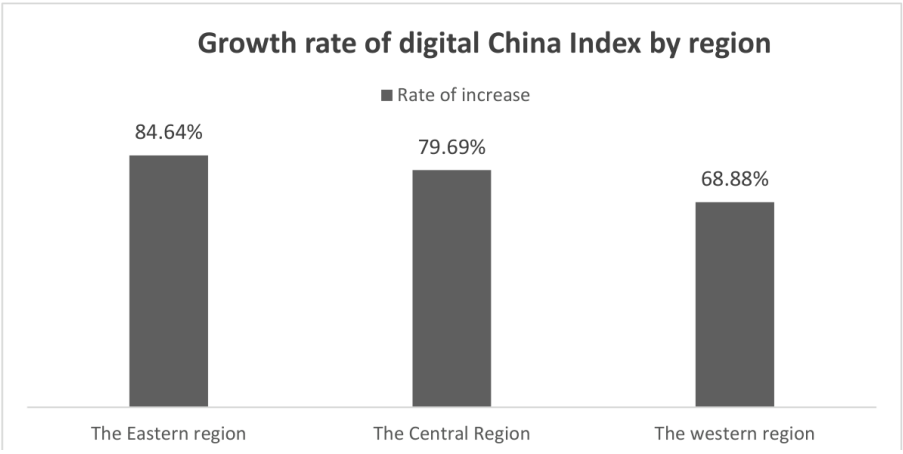

FIGURE 1. Growth rate of digital China Index by region

B. DIGITAL KNOWLEDGE SPILLOVER AS A MECHANISM

A highly digitized regional environment significantly reduces the barriers to information exchange and knowledge dissemination. The concentration of digitally advanced firms, specialized IT service providers, and digitally skilled labor creates a self-reinforcing ecosystem. This environment facilitates "digital knowledge spillover"—the unintentional transmission of technical know-how and advanced digital management practices from leading firms to their regional peers. For a firm making an internal IT investment, this external pool of shared digital knowledge acts as a potent complement, allowing the firm to more effectively implement its new technology, thereby accelerating the return on its IT capital.

C. LITERATURE REVIEW OF REGIONAL DIGITIZATION, IT INVESTMENTS AND CORPORATE PERFORMANCE

In today's rapidly developing economy and widespread use of information technology, it has become an indispensable factor in production and daily life. With the continuous advancement of digital technology, emerging industries are flourishing and becoming a new engine for promoting independent innovation in the real economy. In one of his studies, he proposed a topic titled: The Impact of Digitization Level and Resource Dependence on Green TFP, Liu [7] concluded that digital technology has been deeply integrated into traditional enterprises, and the original business model and sales model have been updated and improved. Can make timely and accurate contributions to the overall development of the company. From a regional perspective, the marginal benefits of digitization in eliminating the wealth gap continue to increase from the west to the central and then to the eastern coastal areas.

In general, the study of digitization level has become an important direction in the current research field. IT is closely related to IT investment, and the level of digitalization reflects the capability of enterprises in IT application, especially in key areas such as new product development. The mutual influence of digitalization level and IT is not only the driving force for the sustainable development of enterprises in the digital era, but also the key driving force to promote the informatization process of the whole society. Future research should dig deeper into the internal relationship between digitalization level and IT, and provide more clear guidance for the digitalization promotion of enterprises.

D. DEFINING THE RESEARCH NOVELTY IN CONTEXT OF EXTERNAL FACTORS

A crucial point of divergence from prior scholarship lies in the specific external factor examined. While extant literature, such as studies focusing on IT value, has explored external moderators like regulatory certainty, market competition, or basic generalized IT infrastructure, these often represent a single facet of the external environment. This research, in contrast, introduces and focuses on the 'regional digitalization level' (RDL) as a nuanced, composite, multi-dimensional composite, multi-dimensional construct. Our RDL measure synthesizes multiple components—including digital infrastructure inputs (e.g., investment in new digital facilities), outputs (e.g., digital patent registration), and applications (e.g., digital usage rate by residents and businesses)—to create a holistic and refined measure of the regional digital ecosystem's maturity. By using this comprehensive RDL moderator, we move beyond simple, single-factor external proxies to rigorously assess how a fully developed regional digital environment—a critical, high-level factor largely unaddressed in its synthesized form—interacts with firm-level IT investment to create value.

Based on the above literature review, since the hot topic of digitalization level has been widely concerned by people in recent years, the corresponding literature is not rich enough, and the research angles and research directions are relatively small. Both the relevant research literature on digitalization level and IT investment and the relevant research literature on digitalization level and corporate performance need to be enriched. Therefore, the innovation of this topic is to explore the mechanism of the impact of information technology

investment on enterprise performance through the mediation of regional digitalization level. Moreover, it contributes to enrich the relevant research literature on the level of digitalization.

E. THEORETICAL

Since the emergence of social capital theory in the 1980s, it has been widely concerned and discussed, not only in the field of economics, but also in the field of sociology, politics and other research fields. Bourdieu, Coleman, and others were the first to propose the theory of "social capital". This is the first time they have introduced the concept of "social capital" into the domestic market. However, Bourdieu and Coleman's understanding of "social capital" is not entirely consistent. Bourdieu [8] extended the concept of "social capital" to his theory of "practice". People believe that this type of capital is closely related to various aspects of society. These aspects are closely related to the social practice of actors. So, we cannot look at social capital alone. Bourdieu attributed Marx's "capital" to "capital", viewing it as a form of "accumulated" labor in both tangible and legal forms. Accumulating labor itself is time-consuming, but the rewards are valuable. What exists in the society is that the basic capital is economic capital, cultural capital and social capital respectively. These capitals can be converted to each other by converting labor, such as monetary/economic capital in exchange for physical and cultural capital. Both social relational capital and social commitment capital can be called social capital. Society is composed of various groups, each possessing a certain amount of economic, cultural, and social resources. Scholars have abundant cultural capital, but lack corresponding economic capital, while entrepreneurs have abundant economic capital but little cultural capital. Various types of capital allocation structures reflect the internal structure of the social domain. In social life, various types of capital manifest in different forms and have varying values. What kind of capital is most effective in a certain aspect. This depends on its scope of application and the conversion cost from one type of fund to another [9].

III. HYPOTHESIS

A. IT INVESTMENTS AND FIRM PERFORMANCE

IT investment plays a crucial role in the sustainable development of enterprises, aiming to maximize IT benefits and facilitate the achievement of strategic objectives. In a narrow sense, IT investment encompasses expenditures on tangible assets such as electronic equipment and software systems, as well as intangible assets like employee training. These investments not only support current operations but also provide critical support for future growth [10]. By continuously upgrading and optimizing IT infrastructure, enterprises can deliver innovative and efficient solutions that enhance business performance. Investments in fixed assets, including electronic equipment and software systems, along with intangible assets generated through employee training, collectively elevate the enterprise's IT application capabilities, thereby maximizing IT benefits. Moreover, integrating IT, which is closely tied to daily business processes, into investment considerations can significantly improve operational efficiency, reduce costs, and drive sustainable development.

H1. There is a positive relationship between IT investment and corporate performance.

B. REGIONAL DIGITALIZATION LEVEL, IT INVESTMENT AND COMPANY PERFORMANCE

Amid the swift progression of economic prosperity and the pervasive dissemination and adoption of information technology, digital technology has incrementally become an indispensable element in the production matrix. The persistent enhancement of digitalization has catalyzed the proliferation of nascent industries and injected a fresh impetus into the innovative potential of the tangible economy. Liu discerned in his scholarly inquiry into the repercussions of digitalization levels and resource dependency on green total factor productivity that the profound amalgamation of digital technology with conventional corporate entities has engendered innovation and elevation in extant business and sales paradigms, empowering enterprises to adeptly and expeditiously apprehend market dynamics, thus fostering their holistic advancement. Ji and Huang elucidated in their empirical examination of the correlation between digitalization levels and corporate value that there exists a direct positive relationship, with their growth trajectories being Conglomerate.

H2. The level of regional digitalization positively moderates the positive relationship between IT investment and firm performance.

IV. RESEARCH DESIGN

A. SAMPLE SELECTION AND DATA SOURCES

This investigation encompasses all publicly-listed corporations trading on the Shanghai and Shenzhen stock exchanges within the People's Republic of China, spanning from the year 2016 to 2023, as its subject matter. A series of stringent protocols have been executed to ascertain the precision and dependability of the research findings. The methodology for the selection of the sample is delineated as follows: Initially, a preliminary screening is performed in accordance with industrial categorization criteria, wherein financial institutions are omitted from the 2016 sample cohort to enhance the representativeness and comparability of the research outcomes. Moreover, entities under Special Treatment (ST) and Suspended Listing (PT) are also excluded to preclude any sample skewing resultant from extraordinary circumstances. Subsequently, to uphold the integrity of the research dataset, instances with incomplete data are excised. This measure is designed to bolster the reliability and quality of the dataset, thereby ensuring that the research conclusions remain unaffected by data deficiencies. Only comprehensive and dependable data are deemed suitable to accurately delineate the actual status of listed corporations. The data

pertaining to IT hardware investments are derived from the electronic apparatus, office equipment, and electronic devices categories under the fixed assets section of the RESET database, while the IT software data are sourced from the computer software and information technology systems categories under the intangible assets segment of the RESET database. The Sample selection process is shown in Table 2:

TABLE 2. Sample selection process

Sample selection procedures	Observations
Firm year observations from the mainboard of Shanghai and Shenzhen Stock Exchanges during 2016–2023 in CSMAR with total assets not missing at least	27472
(1) Excluding observations in the financial industry	-1064
(2) Excluding observations of companies in ST and PT status the study year	-1928
(3) Excluding observations with missing data on IT variable, including hardware investment and software investment	-12672
(4) Excluding observations with missing control variables	-3648
The main sample for regression analysis	8400

B. VARIABLES

In this article, we will explain the performance of the company. Currently, the commonly used methods for evaluating company performance include: return on total assets, return on net assets, Tobin's Q value, and comprehensive performance index. Because accounting indicators measure the short-term results of enterprise operation, and it takes a certain time effect for information technology investment to affect enterprise performance, it may be inaccurate to use such indicators to measure; Comprehensive performance indicators are not only complex but also subjective, which leads to inaccurate results. However, investment in information technology can optimize the business process of the enterprise, improve management efficiency, and enable the enterprise to have certain growth potential, thus increasing the market value of the enterprise. Therefore, this paper refers to the research results of Wang, and finally chooses both Tobin's Q (to capture long-term market valuation) and ROA (to capture short-term operational efficiency and profitability) to measure enterprise performance, providing a comprehensive assessment across different organizational outcomes as required by the IT value literature.

Generally speaking, enterprises with large scale have faster performance growth and stronger ability to withstand pressure. The company's listed Age (Age) is the third control variable concerned. Reflecting the time since the firm went public, older firms are likely to adopt more conservative policies. Through the study of the company's listed years, it can reveal the difference in the formulation of investment strategy of companies in different development stages; Enterprise Growth (Growth). Enterprise growth refers to the ability of an enterprise to grow and develop. Enterprises with high growth tend to show stronger competitiveness and higher returns; Nature of property rights (Property). The behaviors and motivations of executives of enterprises with different Property rights are different. Generally speaking, the nature of an enterprise will affect the degree to which an enterprise pursues performance. In this paper, dummy variables are used to set 1 for soes and 0 for non-soes; Market value (Q). Market capitalization is the value of a company and represents the image of the company. The higher the market value, the greater the company's efficiency; At the board level, the shareholding ratio of the largest shareholder represents the shareholding concentration (Top1) to examine the shareholding structure of the company; Whether the positions of Chairman and general manager are (Dual); In the financial sector, this project will introduce indicators such as Free Cash Flow Per Share (FCFPS) and Corporate Audit Quality (Big4). In addition, industry and year were selected as control variables, as shown in Table 3.

TABLE 3. Definitions of variable

Name	Definition description
Tobin Q	(year-end outstanding market value + non-outstanding share capital or restricted shares * net assets per share + total liabilities)/total assets
ROA	Return on total assets = net profit/average total assets *100%
ITI	(IT hardware investment + IT software investment)/total assets
RDL	The evaluation index of regional digitalization level is constructed, which is divided into three dimensions: input, output and application.
Lev	Total liabilities/total assets
Size	Natural logarithm of the firm's total assets
Age	The number of years the company has been listed
Growth	Annual operating income growth rate = (current year's operating income - last year's operating income)/last year's operating income
Property	It is 1 for soes and 0 otherwise
Q	Total market value of enterprises
Top1	Shareholding ratio of the largest shareholder
Big4	If the audit company is a Big Four international accounting firm, the value is 1; otherwise, it is 0.
FCFPS	(Net profit + non-cash expenses - dividends and capital expenditure)/total number of shares outstanding
Dual	Whether the positions of chairman and general manager are integrated is 1, not 0.

C. RESEARCH METHOD

This article uses STATA statistical software to analyze the correlation between different types of information technology investment and corporate performance through descriptive statistics, correlation analysis, and regression analysis. Then, a mediation effect test model was constructed by examining the impact of regional digitalization on the proposed hypothesis. To explore potential endogeneity issues, we further validated this using the company's fixed effects regression model.

D. MODEL DESIGN

In order to correlate regional digitalization level, IT investment and corporate performance, the relevant regression model constructed in this paper is as follows:

$$\text{TobinQ} = \alpha_0 + \alpha_1 \text{ITI} + \alpha_2 \text{RDL} + \alpha_3 \text{Controls} + \sum \text{Year} + \sum \text{Nind} + \varepsilon \tag{1}$$

$$\text{TobinQ} = \alpha_0 + \alpha_1 \text{ITI} + \alpha_2 \text{RDL} + \alpha_3 \text{ITI} * \text{RDL} + \alpha_4 \text{Controls} + \sum \text{Year} + \sum \text{Nind} + \varepsilon \tag{2}$$

$$\text{ROA} = \alpha_0 + \alpha_1 \text{ITI} + \alpha_2 \text{RDL} + \alpha_3 \text{Controls} + \sum \text{Year} + \sum \text{Nind} + \varepsilon \tag{3}$$

$$\text{ROA} = \alpha_0 + \alpha_1 \text{ITI} + \alpha_2 \text{RDL} + \alpha_3 \text{ITI} * \text{RDL} + \alpha_4 \text{Controls} + \sum \text{Year} + \sum \text{Nind} + \varepsilon \tag{4}$$

Hypothesis 1 was tested using patterns (1) and (3). Both models take IT investment intensity as the independent variable and business performance (Tobin Q, ROA) as the dependent variable. This model also includes all control variables expressed through control. (2) (4) Study the impact of regional digitalization on the relationship between information technology investment and corporate performance, and verify hypothesis 2. The interaction between ITI and RDL refers to the impact of equity on IT investment and company performance. The model of this study was tested by Hausman's test, and finally the binary fixed effects model was selected. The fixed effects model can effectively handle endogenous problems caused by missing variables and explicitly controls for unobserved time-invariant firm factors (μi) and unobserved timespecific shocks common to all firms (year fixed effects δt). This model can effectively explain the individual time effect. So, the following model has been established:

$$\text{TobinQ}_{i,t} = \alpha_0 + \alpha_1 \text{ITI}_{i,t} + \alpha_2 \text{RDL}_{i,t} + \alpha_3 \text{Controls}_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \tag{5}$$

$$\text{TobinQ}_{i,t} = \alpha_0 + \alpha_1 \text{ITI}_{i,t} + \alpha_2 \text{RDL}_{i,t} + \alpha_3 \text{ITI}_{i,t} * \text{RDL}_{i,t} + \alpha_4 \text{Controls}_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \tag{6}$$

$$\text{ROA}_{i,t} = \alpha_0 + \alpha_1 \text{ITI}_{i,t} + \alpha_2 \text{RDL}_{i,t} + \alpha_3 \text{Controls}_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \tag{7}$$

$$\text{ROA}_{i,t} = \alpha_0 + \alpha_1 \text{ITI}_{i,t} + \alpha_2 \text{RDL}_{i,t} + \alpha_3 \text{ITI}_{i,t} * \text{RDL}_{i,t} + \alpha_4 \text{Controls}_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \tag{8}$$

To verify the hypothesis, this article used models (5) and (7) to validate hypothesis 1. In (6) and (8), we introduced RDL (RDL) to validate hypothesis 2 and proposed the positive impact of regional digitalization on IT investment and company performance.

V. EMPIRICAL RESEARCH

A. DESCRIPTIVE STATISTICS OF VARIABLES

Table 4 presents the descriptive statistical analysis of all variables used in this study. After removing invalid and missing samples, a total of 8400 valid observational data were obtained. The study found that Tobin's Q value, mean, and standard deviation were 10.168, 2.213, and 1.438, respectively. This indicates that the selected companies have significant differences in business performance, and the selected sample is representative. Similarly, the company's Return on Assets (ROA) were 0.628, -0.654, and -0.044, respectively. The research results show that there are significant differences in the operating performance of listed companies in China. The investment intensity in information technology is 0.739, 6.023, and 0.019, respectively. The research results show that there are significant differences in the density of information technology investment among enterprises. Some companies believe that investing in information technology is valuable, while others do not. Among them, the average digitalization levels of the regions were 0.796, 3.788, and 0.144, respectively, indicating significant differences in digitalization levels among the regions. Table 4 shows the descriptive statistics of all variables.

TABLE 4. Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Tobin Q	8400	2.213	1.438	0.823	10.168
ROA	8400	-0.044	0.239	-0.654	0.628
ITI	8400	0.739	1.018	0.019	6.023
RDL	8400	0.796	0.671	0.144	3.788
Lev	8400	0.379	0.216	0	0.920
Size	8400	20.93	3.659	0	25.21
Age	8400	12.45	6.644	3	28
Growth	8400	0.0542	0.0539	0	0.308
Property	8400	0.229	0.420	0	1
Q	8400	201.002	376.069	15.762	2753.944
Top1	8400	0.328	0.161	0.031	0.613
Big4	8400	0.0256	0.158	0	1
FCFPS	8400	0.179	0.872	-2.406	3.456
Dual	8400	0.334	0.472	0	1

B. PEARSON CORRELATION ANALYSIS

Using Pearson correlation analysis method, this study explores the impact of regional digitalization level on enterprise information technology investment and performance. From Table 4, it can be seen that ITI, Tobin Q, and ROA all exhibit a bidirectional positive relationship at a significant level of 0.01, which also suggests a hypothesis that IT investment has an impact on company performance. After excluding factors such as industry and year, the correlation of most regression models is less than 0. To ensure high accuracy, after removing multiple collinearity, the mean change of VIF does not exceed 5, indicating that this study is not affected by multicollinearity. Therefore, this study found that investment in information technology has a positive impact on a company's business performance, confirming hypothesis 1, but it may also be influenced by the degree of digitalization in the region. The Pearson correlation coefficient of the variable is shown in Table 5:

TABLE 5. Pearson Correlations of variables

	Tobin Q	ROA	ITI	RDL	Lev	Size	Age	Growth	Property	Q	Top1	Big4	FCFPS	Dual
Tobin Q	1													
ROA	0.282***	1												
ITI	0.166***	0.396***	1											
RDL	0.150***	0.361***	0.824***	1										
Lev	-0.091***	-0.145***	-0.213***	-0.040***	1									
Size	0.001	-0.031***	-0.058***	0.052***	0.388***	1								
Age	-0.053***	-0.159***	-0.365***	-0.165***	0.431***	0.339***	1							
Growth	0.061***	0.022*	-0.058***	-0.054***	0.035***	0.132***	0.080***	1						
Property	-0.124***	0.014	0.145***	0.041**	0.052***	0.291***	0.079***	0.217***	1					
Q	-0.092***	-0.074***	0.142***	0.003	0.033***	0.677***	-0.041***	0.296***	0.190***	1				
Top1	-0.024**	-0.061***	-0.101***	-0.031***	0.120***	0.239***	0.051***	0.029**	0.240***	0.052***	1			
Big4	-0.00800	-0.0110	-0.020*	0.023	0.070***	0.097***	0.062***	0.091***	0.077***	0.0150	0.052***	1		
FCFPS	-0.0120	-0.018	-0.00400	0.027**	0.169***	0.078***	0.090***	0.00600	0.050***	0.027**	0.070***	0.052***	1	
Dual	0.057***	0.121***	0.214***	0.100***	-0.162***	-0.212***	-0.265***	-0.057***	-0.270***	-0.112***	-0.056***	-0.011	-0.025**	1

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

C. REGRESSION ANALYSIS

In this study, five indicators are selected from the three aspects of digital input level, digital output level and digital application level: fixed phone penetration rate (per 100 people), Internet broadband access users proportion (per 100 people), mobile phone penetration rate (per 100 people), the proportion of total post and telecommunications services in GDP, and Internet penetration rate (number of Internet users/number of resident population) Measure regional digitization level. The results are obtained through the KMO test and Bartlett's test of sphericity. The KMO value is 0.714 and greater than 0.5, and the p value of Bartlett's test of sphericality is 0.000, indicating that the result is significant and suitable for PCA. Table 6 shows the impact of information technology investment on company performance. The first and third columns of the table show the results of regression analysis on (1) and (3) using observation data from overall sampling, while the second and fourth columns represent the regression analysis results including all sample interactions. From columns 1 and 3, it can be seen that both information technology investment and company coefficients are positive at a significant level of 1%, which confirms our hypothesis 1 that information technology investment has a significant promoting effect on company performance.

In addition, this study also found that the degree of regional digitization has a disruptive effect on the impact of information technology investment and company performance. Under the influence of regional digitalization, the coefficient of the relationship between IT investment and enterprise performance reached 3.89, which is significant at the 1% level, while the coefficient of ITI * RDL reached 5.20, which is significant at the 1% level. In column 4, the impact of information technology investment on corporate performance reached 5.46, reaching a significant level of 1%. However, the ITI * RDL coefficient is 4.24, reaching a significance level of 1%. Therefore, this study proposes the following hypothesis: there is a positive mediating effect of regional digitalization on the relationship between information technology investment and company performance.

Through regression analysis controlling for variables, we found a significant negative correlation between asset liability ratio and corporate performance (Tobin Q, ROA). At the same time, company size has a significant positive impact on company performance (Tobin Q, ROA), indicating that the larger the company size, the greater the investment in production and management innovation in order to achieve long-term development, thereby improving company performance. So, the growth of a company is directly proportional to its performance.

TABLE 6. Results of regional digitization level, IT investment and corporate performance

	(1) Total Sample TobinQ	(2) Interaction Effect TobinQ	(3) Total Sample ROA	(4) Interaction Effect ROA
ITI	0.805***	0.713***	0.350***	0.290***
	(4.12)	(3.89)	(3.43)	(5.36)
RDL	0.187***	0.214***	0.675***	0.722***
	(7.16)	(8.58)	(5.91)	(5.44)
ITI*RDL		0.258***		0.055***
		(5.20)		(4.24)
Lev	-0.003	-0.022***	-0.016**	-0.058***
	(-0.55)	(-9.03)	(-2.12)	(-10.83)
Size	0.004	0.007***	-0.002	0.017***
	(0.93)	(3.08)	(-0.43)	(3.21)
Age	-0.011	-0.052***	-0.022**	-0.156***
	(-1.62)	(-16.94)	(-2.35)	(-23.45)
Growth	-0.003	-0.003	-0.005	-0.005
	(-0.53)	(-1.09)	(-0.69)	(-0.97)
Property	-0.007	-0.008***	-0.012**	-0.024***
	(-1.58)	(-2.79)	(-2.02)	(-4.09)
Q	0.048**	0.011***	0.072**	0.038***
	(2.27)	(3.98)	(2.37)	(8.48)
Top1	-0.006	0.007	-0.006	0.003
	(-1.14)	(0.49)	(-0.63)	(0.08)
Big4	0.018***	-0.036***	0.032***	-0.088***
	(3.20)	(-11.53)	(4.40)	(-14.74)
FCFPS	0.003	0.004*	0.100***	0.007
	(1.40)	(1.84)	(3.61)	(1.14)
Dual	0.017*	0.046***	0.032**	0.123***
	(1.69)	(10.46)	(1.34)	(15.72)
Nind	Controls	Controls	Controls	Controls
Year	Controls	Controls	Controls	Controls
Constant	-0.018*	-0.100***	-0.281*	-0.165***
	(-1.72)	(-6.97)	(-1.81)	(-4.44)
Observations	8,400	8,400	8,400	8,400
R-squared	0.372	0.268	0.337	0.284

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

D. FIXED EFFECT MODEL REGRESSION ANALYSIS

On this basis, we also designed a fixed effects model to eliminate endogeneity issues. Table 7 shows the fixed effect pattern of information technology investment and company performance, which is influenced by the degree of digitalization in different regions. Columns (5) and (7) show the regression analysis results of models 5 and (7) for the overall sample that will serve as the observation target; (6) and (8) are the results of regression analysis on the full sample interaction effect model (6) and (8). In the 5th and 7th data sets, there is a significant positive correlation between information technology investment and corporate performance (Tobin Q, ROA), with coefficients of 5.68 and 7.21, both of which are significant at the 1% significance level.

TABLE 7. Fixed effect results of ownership property, IT investment and corporate performance

	(5) Total Sample $\text{TobinQ}_{i,t}$	(6) Interaction Effect $\text{TobinQ}_{i,t}$	(7) Total Sample $\text{ROA}_{i,t}$	(8) Interaction Effect $\text{ROA}_{i,t}$
ITI	0.618***	0.747***	0.201***	0.306***
	(5.68)	(5.33)	(7.21)	(7.61)
RDL	0.186***	0.181***	0.661***	0.668***
	(19.69)	(25.29)	(29.59)	(19.26)
ITI*RDL		0.242***		0.044***
		(4.68)		(3.36)
Lev	-0.003	-0.006	-0.028***	-0.020***
	(-0.55)	(-1.51)	(-2.86)	(-3.26)
Size	-0.002	0.002	-0.025**	-0.007
	(-0.43)	(0.56)	(-2.42)	(-1.38)
Age	-0.022**	-0.016	-0.008	0.060***
	(-2.35)	(-0.15)	(-0.98)	(5.82)
Growth	-0.005	-0.009*	0.009	-0.018**
	(-0.69)	(-1.76)	(0.85)	(-2.56)
Property	-0.012**	-0.001	-0.003	-0.003
	(-2.02)	(-0.28)	(-0.36)	(-0.41)
Q	0.072**	-0.005*	0.064	-0.009*
	(2.37)	(-1.70)	(0.71)	(-1.93)
Top1	-0.006	0.030	0.007	0.063
	(-0.63)	(1.45)	(0.42)	(1.49)
Big4	0.032***	-0.002	0.010	-0.002
	(4.40)	(-0.40)	(1.05)	(-0.20)
FCFPS	0.004*	0.002	0.004	0.004**
	(1.84)	(1.47)	(1.23)	(2.41)
Dual	0.017*	0.014*	0.003	0.021*
	(1.78)	(1.65)	(0.72)	(1.86)
Nind	Controls	Controls	Controls	Controls
Year	Controls	Controls	Controls	Controls
Constant	-0.155***	-0.062***	-0.004*	-0.085***
	(-9.32)	(-5.09)	(-1.72)	(-6.33)
Observations	8,400	8,400	8,400	8,400
R-squared	0.360	0.269	0.327	0.223

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

E. ROBUSTNESS ANALYSIS

To address potential structural breaks and time-varying effects within the 2016–2023 panel data, which spans a period of significant digital and macroeconomic shifts, we perform an additional robustness test by splitting the sample into two equal sub-periods (2016–2019 and 2020–2023) and re-estimating the fixed effects models (6) and (8). This sub-period analysis ensures the consistency and stability of the moderating effect across different phases of China's digital economy development. On this basis, by introducing independent variables, information technology investment portfolios, and independent variable substitution methods, we perform a key sensitivity analysis by using Return on Equity (ROE) as an alternative accounting-based dependent

variable instead of ROA to test the original model and the original fixed effects model. For the sake of simplicity, Tables 8 and 9 only list the coefficients of the main variables involved. All robustness tests show that IT investment has a significant positive impact on company performance, and the positive mediating effect of the interaction effect (ITI * RDL) is also significant. The research results confirm the reliability of the research findings.

TABLE 8. Robust test of regional digitization level, IT investment and corporate performance

	(9) Total Sample TobinQ	(10) Interaction Effect ROA	(11) Total Sample $\mathrm{TobinQ}_{i,t}$	(12) Interaction Effect $\mathrm{ROA}_{i,t}$
L. ITI	0.553***	0.195***	0.316***	0.130***
	(7.62)	(4.99)	(4.84)	(3.94)
RDL	0.051***	0.033***	0.126***	0.648***
	(4.41)	(3.57)	(5.64)	(50.57)
ITI*RDL		0.500***		0.148***
		(9.77)		(4.79)
Other Controls	included	included	included	included
R-squared	0.414	0.309	0.235	0.302

TABLE 9. Robust test of regional digitization level, IT investment and corporate performance

	(9) Total Sample ROE	(10) Interaction Effect ROE	(11) Total Sample $\mathrm{ROE}_{i,t}$	(12) Interaction Effect $\mathrm{ROE}_{i,t}$
ITI	0.427***	0.406***	0.358***	0.328***
	(11.26)	(10.38)	(8.31)	(7.45)
RDL	0.221***	0.068***	0.048**	0.010***
	(3.87)	(6.40)	(2.52)	(3.35)
ITI*RDL		0.022**		0.029**
		(2.01)		(2.12)
Other Controls	included	included	included	included
R-squared	0.243	0.238	0.175	0.176

VI. CONCLUSION

In this study, OLS estimation and the fixed effects model are used to test the relationship between IT investment and firm performance, and to examine the moderating role of regional digitalization, a statistical approach that is directly relevant to the industry for empirically analyzing how investments in smart technology are influenced by the surrounding regional digital ecosystem to impact operational efficiency and profitability. The regression results show that IT investment has a significant positive impact on firm performance, and as IT investment increases, firm performance improves, which verifies Hypothesis 1. At the same time, the level of regional digitalization also plays a positive moderating role in the positive correlation between IT investment and firm performance, which verifies Hypothesis 2. Furthermore, we observe that this positive moderating effect is significantly stronger in China's Eastern regions. This regional divergence is not solely a reflection of the difference in raw digitalization scores, but highlights the critical role of complementary regional endowments. Specifically, the Eastern regions benefit from a high density of digital-savvy talent, superior institutional quality, high patent registration rates, and deeper financial markets with greater digital venture capital density, all of which substantially enhance the effectiveness of internal IT investments and accelerate their conversion into performance gains. We find that the higher the level of digitalization in a region is, the more emphasis enterprises attach to IT investment, which in turn promotes the improvement of corporate performance. The robustness test further verifies the reliability of the results of regression analysis. By replacing the explained variable and lagging the explanatory variable by one period, the consistency of the results further consolidates the stability and accuracy of the research conclusion. Crucially, the combined application of year fixed effects and the new sub-period robustness check confirms that our findings are not skewed by unobserved common time trends or structural breaks during this dynamic period of digital development. This indicates that the positive impact of IT investment on firm performance derived from this study and the moderating effect of the regional level of digitalization on this relationship have a high degree of confidence. This study explores the relationship between IT investment and firm performance and the influence of moderating factors in depth through a multifaceted empirical analysis. The results provide useful reference and guidance for enterprises when making IT investment decisions, and provide theoretical basis for enterprises to improve performance and achieve sustainable development. At the same time, the study puts forward practical and feasible suggestions on the moderating effect of regional digitalization level, which provides support for enterprises to make strategic decisions more flexibly in different situations. However, recognizing the need for further nuance in this relationship, future research should explore two critical extensions: first, testing for a non-linear (e.g., diminishing marginal returns) effect of Regional Digitalization Level (RDL) itself; and second, analyzing whether the impact of RDL differs across specific types of IT investments (e.g., foundational ERP systems versus advanced data analytics tools) to provide granular strategic guidance.

AUTHOR CONTRIBUTIONS

MEIYI SONG designed, collected and analyzed the data, and drafted the manuscript. MEIYI SONG conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. MEIYI SONG participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

FUNDING

This research was supported by, Research on the Evolution Mechanism and Policy Innovation of Green Finance in Facilitating the Achievement of the "Dual Carbon" Goals(24JZ071).

ACKNOWLEDGEMENTS

Not applicable.

REFERENCES

[1] A. Ilmudeen and Y. Bao, "IT strategy and business strategy mediate the effect of managing IT on firm performance: Empirical analysis," Journal of Enterprise Information Management, vol. 33, no. 6, pp. 1357-1378, 2020, doi: 10.1108/JEIM-03-2019-0068.

[2] J. Liu, Y. Gong, J. Zhu, and R. Titah, "Information technology and performance: Integrating data envelopment analysis and configurational approach," Journal of the Operational Research Society, vol. 73, no. 6, pp. 1278-1293, 2022, doi: 10.1080/01605682.2021.1907238.

[3] Y. Shi, "The Future of Industry: Human-Centric Approaches in Digital Transformation," Cham, SWITZERLAND: Springer Nature Switzerland; 2024. The Impact of Digital Transformation on Labor Productivity of Chinese Small and Medium-Sized Enterprises (SMEs); p. 473-488, doi: 10.1007/978-3-031-66801-2_30.

[4] A. Goldfarb and C. Tucker, "Digital Economics," Journal of Economic Literature, vol. 57, no. 1, pp. 3-43, 2019, doi: 10.1257/jel.20171452.

[5] J. Fan and L. He, "The impacts of digital transformation on firm performance in China: The moderating role of supply chain concentration," International Journal of Logistics: Research & Applications, vol. 28, no. 8, pp. 910-929, 2025, doi: 10.1080/13675567.2023.2272830.

[6] R. Katz and F. Callorda, "Accelerating the development of Latin American digital ecosystem and implications for broadband policy," Telecommunications Policy, vol. 42, no. 9, pp. 661-681, 2017, doi: 10.1016/j.telpol.2017.11.002.

[7] S. Shang and L. Feng, "The effect of digitalization on urban green total factor productivity: Empirical evidence from China," Environment, Development and Sustainability, vol. 27, pp. 28943–28963, 2025, doi: 10.1007/s10668-024-05013-6.

[8] P. Bourdieu, "The Logic of Practice," Stanford, California, USA: Stanford University Press; 1990. Studies in philosophy & education, doi: 10.1007/BF00680104.

[9] H. Ali-Hassan, "Social Capital Theory," VS Verlag für Sozialwissenschaften, 2011, doi: 10.1007/978-3-531-92646-9.

[10] H. S. Kim and S. C. S. Jang, "CEO Overconfidence and Firm Performance: The Moderating Effect of Restaurant Franchising," Cornell Hospitality Quarterly, vol. 62, no. 2, pp. 276-292, 2021, doi: 10.1177/1938965519899926.