



# Digital Transformation, Business Environment and New Productivity: Based on the Experience and Evidence of Specialized, Refined, Distinctive and Innovative Listed Companies

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**How to cite this paper:** Zhong, H.S. and Han, Y.Q. (2026) Digital Transformation, Business Environment and New Productivity: Based on the Experience and Evidence of Specialized, Refined, Distinctive and Innovative Listed Companies. *Open Access Library Journal*, 13: e15167.

<https://doi.org/10.4236/oalib.1115167>

**Received:** March 13, 2026

**Accepted:** March 21, 2026

**Published:** March 24, 2026

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## Abstract

In the context of the digital economy, digital transformation has become a key driver for enterprises to develop new quality productivity, while the business environment plays a crucial role in influencing both digital transformation and productivity growth. However, theoretical research on the relationship between digital transformation, business environment, and new quality productivity remains limited. This study examines annual data from China's specialized, refined, distinctive, and innovative (SRDI) A-share listed companies (2018-2022) to explore how digital transformation impacts new quality productivity levels and assesses their positive correlation and heterogeneity factors. Empirical results reveal: 1) Digital transformation significantly enhances new quality productivity levels; 2) The effect of digital transformation on productivity growth is moderated by business environment quality. When the business environment exceeds a threshold level, digital transformation boosts productivity; however, when it falls below the threshold, its positive impact weakens or becomes insignificant. These findings provide valuable insights for formulating policies to accelerate digital transformation and strengthen new quality productivity development.

## Subject Areas

Environmental Economics

## Keywords

Digital Transformation, Business Environment, New Quality Productive Forces

## 1. Introduction

New-type productive forces, characterized by innovation-driven development, represent an advanced form of productivity that aligns with the new development philosophy. In September 2023, President Xi Jinping first proposed at the Symposium on Promoting the Comprehensive Revitalization of Northeast China in the New Era: “Accelerate the formation of new-type productive forces to enhance new growth drivers.” This initiative holds significant strategic importance for elevating China’s productivity levels and advancing Chinese-style modernization in the new era. New-type productive forces, powered by stronger innovation-driven momentum, achieve organic integration of technological breakthroughs, economic development, and industrial upgrading. Scholars have interpreted the essence of new-type productive forces through two perspectives: connotative features and theoretical logic, focusing on “new” and “quality” [1]. Other researchers have summarized the formation conditions and mechanisms, identifying innovation-driven development, industrial foundations, and future strategic planning as key focal points. Based on core principles and conceptual definitions, some scholars have made preliminary attempts to measure new-type productive forces through indicator systems [2]. Regarding strategies to accelerate their cultivation, strengthening scientific and technological innovation leadership and developing original disruptive technologies remain the core engines driving growth. Compared to traditional productive forces, new-type productive forces place greater emphasis on innovation-driven development.

To develop new-quality productive forces, we must firmly grasp the “steering wheel” of scientific and technological innovation, creating new industries, cultivating new momentum, and forming new advantages [3]. In this process, the role of digital transformation has gradually become prominent. Digital transformation, especially that driven by next-generation information technologies, has become a significant driving force for corporate transformation. Digital transformation accelerates knowledge spillovers among enterprises, thereby promoting the improvement of their total factor productivity, serving as an endogenous growth driver for the economy. The report of the 20th National Congress of the Communist Party of China pointed out the need to “accelerate the building of a manufacturing powerhouse, a quality powerhouse, an aerospace powerhouse, a transportation powerhouse, a cyber powerhouse, and a digital China.” In recent years, a digital wave, primarily represented by the metaverse, big data, artificial intelligence, 5G communications, and the Internet of Things, has swept across, becoming a crucial driving force for industrial digitalization [4].

In recent years, scholars have conducted extensive and in-depth research on various aspects of the business environment, including its relationship with corporate or regional socio-economic development, optimization strategies for urban and provincial business environments, and its impact on enhancing new-type productive forces in enterprises. Optimizing the business environment is a large-scale and systematic project that requires comprehensive consideration of multi-

ple factors to achieve high-quality economic development. Improved business environments can significantly enhance corporate digital transformation efficiency and innovation capabilities. Among enterprises in different regions, those in eastern China exhibit the highest business environment standards, followed by western regions with relatively advanced digital transformation levels, while central regions rank second and western regions have the weakest business environment [5] [6]. Optimized business environments can substantially increase corporate R&D investment, thereby accelerating digital technological reforms and achieving more effective digital transformation, which in turn drives economic growth and enhances new-type productive forces. Existing literature on business environment research employs diverse methodologies, including bibliometric analysis, entropy weighting, and holistic/dimensional analysis. These approaches help scholars better understand the inherent complexity and dynamism of business environments [7]. Future research may focus more on interdisciplinary and cross-domain comprehensive studies. By synthesizing and comparing theories on business environment both domestically and internationally, this paper investigates the impact of business environment quality on digital transformation and the enhancement of enterprises' new-type productive forces [8] [9].

The marginal contributions of this paper are as follows: First, focusing on the micro-level of enterprises, this study examines listed companies specializing in niche markets and innovative technologies to explore how digital transformation impacts their new-type productivity, providing insights for enhancing corporate productivity. Second, unlike previous research that primarily focused on internal factors such as technological innovation, innovation activity, and R&D capabilities, this paper identifies the business environment as an external driver of digital transformation, analyzing how it facilitates productivity growth during the digitalization process. This perspective expands the research framework for understanding the impact of digital transformation on new-type productivity. Third, through theoretical and empirical analysis, the study reveals the nonlinear effects of digital transformation on new-type productivity, enriching relevant theoretical research.

## 2. Theoretical Analysis and Research Hypothesis

### 2.1. Digital Transformation and New Productivity of Enterprises

The advent of the digital economy era has disrupted traditional development models of the real economy, driving enterprises to accelerate technological upgrades and achieve transformation and upgrading. Digital transformation not only accelerates corporate development but also enhances technical capabilities, helping businesses identify new directions for growth in the new phase [10] [11]. Enterprises can improve their new-type productivity through three aspects: tools, workforce, and objects of labor. First, regarding the enhancement of labor tools: 1) Digital transformation enables enterprises to establish direct communication channels with consumers, allowing them to identify potential market demands

and conduct targeted R&D, thereby reducing production costs and operational uncertainties, which in turn boosts new-type productivity; 2) Digital transformation generates massive data, enabling enterprises to monitor the entire process of R&D, production, and sales through data-driven approaches, promoting tool innovation, improving the success rate of corporate innovation, and thus enhancing new-type productivity [12]. Second, the impact of digital transformation on workforce manifests in how digital technology platforms for industry-academia-research collaboration foster an innovative atmosphere, cultivate innovative thinking and capabilities among managers at all levels, improve employee operational skills, enhance learning efficiency, and allow enterprises to accumulate more practical experience from real-world cases, further strengthening new-type productivity. Finally, regarding the enhancement of objects of labor, in the digital economy era, objects of labor are no longer limited to traditional material forms; data and information have become new objects of labor [13]. Digital transformation enables enterprises to utilize data and other new objects of labor more efficiently, improving production and operational efficiency while reducing costs, thereby enhancing new-type productivity. Based on the above analysis, this paper proposes the following research hypotheses:

H1: Digital transformation can significantly enhance the level of new-type productivity in enterprises.

## **2.2. Threshold Effect between Business Environment and Digital Transformation and New Productivity Level of Enterprises**

The advancement of new-type productivity in enterprises through digital transformation requires corresponding business environments to provide essential support and safeguards. A business environment can be understood as a comprehensive system of external conditions that enterprises face in their daily operations, management, and innovation processes [14]. It serves as both a conduit for accessing external resources and a constraint on corporate development. Digital transformation, characterized by its integrative, developmental, and self-generating nature, introduces new organizational forms and institutional logic during the enhancement of new-type productivity, yet remains constrained by the business environment. When business environments operate at varying developmental stages, the efficiency of circulating production factors, knowledge resources, and products/services among market entities differs significantly. This directly impacts enterprises' innovation costs and returns [15], which in turn exerts systemic effects on digital transformation strategies. Consequently, the quality of the business environment directly influences the market conversion outcomes of digital transformation, thereby playing a pivotal role in enhancing enterprises' new-type productive forces. According to ecosystem theory analysis, a favorable business environment can provide development space for enterprises' scientific research activities, alleviate financial pressure, and reduce potential barriers faced by economic entities. A high-level business environment can provide institutional sup-

port and resource guarantees for enterprises to promote the enhancement of new-quality productivity through digital transformation. In this process, with the improvement of government digital governance capabilities, market efficiency, and the level of rule of law, the survival costs of enterprises can be reduced, and the exclusivity of innovation value and the flow of knowledge resources can be effectively balanced. Therefore, optimizing the business environment helps the smooth launch and sustainable development of digital transformation, providing stable external conditions for enterprises to drive new-quality productivity through digital transformation. A high-quality business environment can attract more digital economy participants to join the digital transformation process, fostering an open and collaborative digital industrial innovation ecosystem. This helps enterprises establish new economies of scale, scope, and network within their business systems [16], providing more market opportunities for leveraging digital transformation to achieve new-quality productivity. Consequently, this further strengthens the positive impact of digital transformation on the development of new-quality productivity [17]. Therefore, this paper proposes the following hypotheses:

H2: The relationship between business environment and digital transformation may exhibit a “threshold effect” in influencing the level of new-type productivity. Regions with higher business environment levels are more conducive to enhancing the role of digital transformation in boosting new-type productivity, whereas regions with lower business environment levels tend to suppress this positive impact.

### 3. Research Design

#### 3.1. Sample Selection and Data Sources

Specialized, refined, distinctive, and innovative (SRDI) enterprises epitomize China’s vision of “small and medium-sized enterprises (SMEs) achieving great things,” distinguished by their specialization, precision, uniqueness, and innovation. As a vital force in advancing new industrialization and developing new productive forces, these enterprises have been repeatedly highlighted in policy documents as essential for enhancing their innovation capabilities to maintain their “golden reputation.” By June 2024, China had cultivated over 140,000 SRDI SMEs, forming a substantial industrial base. In digital transformation and productivity advancement, SRDI enterprises have implemented the “Digital Empowerment, Technological Innovation, Quality Standards, and Brand Value” SME initiative, which provides a solid foundation for this analysis.

This study employs annual data from China’s specialized, refined, distinctive, and innovative (SRDI) A-share listed companies (2018-2022) as its research sample. Business environment metrics are primarily sourced from the National Bureau of Statistics database, while digital transformation data is extracted from annual reports of listed companies published on Juchao Information Network. Using Python software and text mining techniques, we analyzed keyword frequency distributions related to digital transformation in these corporate reports. New quality productivity data is obtained from the CSMAR database, with samples

containing missing productivity data and \*ST/ST-class companies excluded. The final dataset comprises 3745 observations.

### 3.2. Variable Declaration

- **New Quality Productivity (Npro).** Building upon an analysis of Npro's fundamental concepts, Zhang Xiu'e developed an evaluation framework for new enterprises' Npro by incorporating methodologies from Song Jia et al. and Ren Yuxin et al., with entropy-based weighting applied to multi-level indicators. This study employs the two-factor theory of productivity and Song Jia *et al.*'s (2024) entropy method to measure Npro, which is a multi-criteria weighting approach rooted in information entropy theory. The method assigns varying weights to indicators through entropy value analysis for comprehensive evaluation [18].
- **Explanatory variable: Digital Transformation Level (Indig).** This study draws on Wu Fei *et al.* [19]. research, employing text analysis techniques to extract and statistically analyze keywords closely related to digital transformation—such as big data, blockchain, artificial intelligence, cloud computing, and digital technologies—from the annual reports of selected specialized, refined, distinctive, and innovative (SRED) A-share listed companies. The total frequency of these keywords is then increased by 1, and the logarithm of the result is used to characterize the level of digital transformation.
- **Threshold variable: Business Environment (Do-bus)** This study adopts the methodologies of Yang Renfa *et al.* [20]. to construct a provincial-level business environment evaluation index system from four perspectives: macroeconomic environment, market environment, infrastructure, and policy environment. Considering data continuity and availability, the evaluation system comprises four primary indicators and 151 secondary indicators, including: macroeconomic environment (per capita GDP, average wage level, consumption rate, per capita fixed asset investment, GDP growth rate); market environment (foreign trade dependence, total factor productivity, employment numbers, financing constraints); infrastructure (per capita urban road area, number of hospital beds, power supply capacity, total freight volume); and policy environment (government intervention, corporate tax burden). The entropy weight method is then applied to determine the weights of each indicator, and the final comprehensive business environment index is derived by summing the weighted values.
- **Controlled variable:** Based on the previous literature, the control variables are selected as the following: enterprise size, asset-liability ratio, two positions combined, board size, the top ten shareholders' shareholding, property right nature, and Tobin Q value.

### 3.3. Model Specification

To examine the impact of digital transformation on enterprises' new-type produc-

tivity, this paper establishes the following benchmark testing model:

$$Npro_{i,t} = a_0 + a_1 Indig_{i,t} \pm controls_{i,t} + \sum year + \sum Industry_{i,t} + \varepsilon_{i,t} \quad (1)$$

In this model, the dependent variable  $Npro$  represents the development level of new-type productivity in company  $i$  during year  $t$ . The core explanatory variable  $Indig_{i,t}$  indicates the degree of digital transformation in company  $i$  during year  $t$ .  $Controls_{i,t}$  denote a set of control variables affecting the development of new-type productivity.  $Year$  and  $Industry_{i,t}$  serve as dummy variables reflecting time and industry-specific characteristics, respectively, to account for time and industry fixed effects. The random disturbance term  $\varepsilon_{i,t}$  ensures error range. To examine how varying levels of business environment influence the relationship between digital transformation and new-type productivity development, this study employs a threshold regression model for threshold testing. Proposed by Hansen in 1999, this model categorizes research samples into distinct groups based on observed variable threshold values, with the number and specific thresholds determined by sample data. Existing threshold effect models typically test up to three thresholds. Since the number of thresholds prior to measurement remains unknown, this study systematically evaluates single-, dual-, and triple-threshold models to avoid missing any potential thresholds. The most appropriate threshold effect model is then selected through practical testing.

$$Npro_{i,t} = \varphi_1 Indig_{i,t} \times I(Dobus_{i,t} \leq Y_0) + \varphi_2 I(Dobus_{i,t} > Y_0) + \varphi_3 controls + \sum year + \sum industry + \varepsilon_{i,t} \quad (2)$$

$$Npro_{i,t} = \varphi_1 Indig_{i,t} \times I(Dobus_{i,t} \leq Y_1) + \varphi_2 I(Y_1 < Dobus_{i,t} \leq Y_2) + \varphi_3 Indig_{i,t} \times (Dobus > Y_2) + \varphi_3 controls + \sum year + \sum industry + \varepsilon_{i,t} \quad (3)$$

$$Npro_{i,t} = \varphi_1 Indig_{i,t} \times I(Dobus_{i,t} \leq Y_1) + \varphi_2 Indig_{i,t} \times I(Y_1 < Dobus_{i,t} \leq Y_2) + \varphi_3 Indig_{i,t} \times I(Y_2 < Dobus_{i,t} \leq Y_3) + \varphi_4 Indig_{i,t} \times I(Dobus > Y_3) + \varphi_3 controls + \sum year + \sum industry + \varepsilon_{i,t} \quad (4)$$

In the threshold model,  $Dobus_{i,t}$  denotes the business environment level of province  $i$  where company  $i$  is located in year  $t$ , with all other variables defined as in the baseline model.

## 4. Empirical Results Analysis

### 4.1. Statistical Description and Correlation Analysis

The descriptive statistics of the variables are presented in **Table 1**. The new quality productivity ( $Npro$ ) of listed companies averaged 5.850 with a standard deviation of 2.574, ranging from a minimum of 1.284 to a maximum of 24.330. This indicates significant disparities in  $Npro$  levels among sample enterprises, with some still in the low-end range requiring improvement. Digital transformation ( $Indig$ ) averaged 1.877 with a standard deviation of 1.517, showing a wide range from 0.000 to 6.248. This highlights notable differences in digital transformation capabilities across enterprises, suggesting some still lack awareness of its operational

importance. The business environment (Dobus) averaged 0.309 with a standard deviation of 0.085, ranging from 0.123 to 0.417. The substantial gap between the maximum and minimum values reflects regional disparities in business environment development. Among control variables, the minimum and maximum values of asset-liability ratio (lev), enterprise size (size), Top10 shareholder ownership rate, and Tobin's Q (Tobinq) show significant differences, indicating substantial variations in operational conditions and asset structures among selected sample enterprises.

**Table 1.** Descriptive statistics.

variable	sample capacity	average value	standard deviation	minimum	maximum	25th percentile	50th percentile	75th percentile
Indig	3745	1.877	1.517	0.000	6.248	0.693	1.609	2.996
npro	3745	5.850	2.574	1.284	24.330	4.192	5.339	6.827
dobus	3745	0.309	0.085	0.123	0.417	0.237	0.323	0.366
size	3745	21.580	0.849	19.080	26.390	20.970	21.530	22.080
lev	3745	0.363	0.182	0.014	1.957	0.218	0.350	0.482
dual	3745	0.411	0.492	0.000	1.000	0.000	0.000	1.000
board	3745	2.044	0.188	1.386	2.565	1.946	2.079	2.197
top10	3745	55.480	14.000	12.340	94.940	45.350	56.030	66.570
soe	3745	0.128	0.334	0.000	1.000	0.000	0.000	0.000
tobinq	3745	2.209	1.493	0.761	22.570	1.419	1.787	2.445

**Table 2.** Correlation analysis.

variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
npro	1.000									
Indig	0.194***	1.000								
dobus	-0.034**	0.116***	1.000							
size	0.017	0.045***	-0.011	1.000						
lev	-0.083***	0.010	0.013	0.328***	1.000					
dual	0.023	0.035**	0.101***	-0.089***	-0.065***	1.000				
board	0.017	-0.065***	-0.125***	0.138***	0.021	-0.125***	1.000			
top10	-0.110***	-0.155***	0.043***	-0.164***	-0.127***	0.064***	0.001	1.000		
SOE	0.070***	-0.054***	-0.208***	0.090***	0.072***	-0.206***	0.210***	-0.029*	1.000	
Tobinq	0.198***	0.052***	-0.047***	-0.214***	-0.163***	0.040**	-0.063***	0.034**	0.010	1.000

a. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1.

The correlation analysis among variables is presented in **Table 2**. The correlation coefficient between New Productivity Level (Npro) and Digital Transformation (Indig) is 0.194, demonstrating a statistically significant positive correlation at the 1% significance level. This indicates that digital transformation positively impacts the enhancement of corporate New Productivity Level, preliminarily validating Hypothesis 1 of this study. Furthermore, the absolute values of correlation coefficients among other variables are all below 0.35. Among the control variables, the debt-to-asset ratio, the shareholding of the top ten shareholders, property rights nature, and Tobin's Q value are all significantly correlated with corporate New Productivity Level at the 1% significance level. The Variance Inflation Factor (VIF) values are all substantially below 10, indicating no severe multicollinearity issues among the research variables.

## 4.2. Regression Analysis of Basic Level

**Table 3.** Regression result of basic model.

	(1)	(2)	(3)	(4)
	npro	npro	npro	npro
Indig	0.081*** (2.750)	0.082*** (2.792)	0.082*** (2.787)	0.079*** (2.709)
dual		0.126** (2.115)	0.125** (2.068)	0.137** (2.261)
board			-0.036 (-0.196)	-0.052 (-0.281)
soe				0.217* (1.804)
cons	5.699*** (100.376)	5.645*** (90.682)	5.720*** (14.707)	5.724*** (14.722)
N	3745	3745	3745	3745
R <sup>2</sup>	0.003	0.004	0.004	0.005
F	7.564	6.023	4.027	3.836

b. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1.

Based on the F-test results, this study obtained an F-test coefficient of 35.79 with a P-value of 0.0000. The Hausman test also yielded a coefficient of 108.08 and a corresponding P-value of 0.0000, indicating that the fixed effects model is more

appropriate for this research. Consequently, a two-way fixed effects model was adopted for subsequent empirical analysis. **Table 3** presents the fixed effects regression results of digital transformation (Indig) on the level of new quality productivity (Npro) in enterprises. As shown in **Table 3**, the regression coefficient in column (1) (without controlling any factors) is 0.081. When controlling for the variables “two-in-one” (a policy promoting dual-role integration), “board size,” and “property rights nature” in columns (2) - (4), the regression coefficients of digital transformation on Npro sequentially become 0.082, 0.082, and 0.079. Notably, the coefficients consistently show positive impacts on Npro, all remaining significant at the 1% level. This demonstrates that the business environment exerts a significant positive influence on the development of new quality productivity, thereby validating Hypothesis H1.

### 4.3. Robustness Test

**Table 4.** The lagging phase regression of digital transformation.

	(1)	(2)	(3)
	Indig	npro	npro
Indigg	0.167*** (8.639)		0.130*** (3.934)
size		-0.218*** (-3.792)	-0.363*** (-5.138)
lev		-0.114 (-0.566)	-0.495** (-2.168)
dual		0.139** (2.299)	0.116 (1.638)
board		0.027 (0.143)	0.088 (0.397)
top10		-0.006** (-2.164)	0.003 (0.801)
soe		0.200* (1.662)	0.109 (0.718)
tobinq		0.048*** (2.848)	0.006 (0.307)
_cons	1.624*** (44.123)	10.686*** (8.128)	13.285*** (8.300)
N	2996	3745	2996
R <sup>2</sup>	0.032	0.012	0.024
F	74.628	4.977	6.986

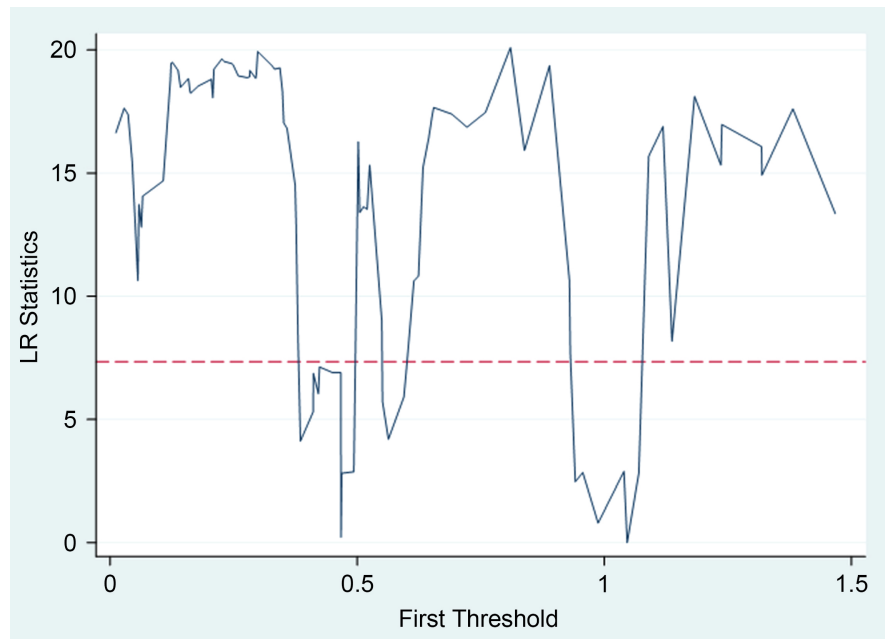
c. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1.

This study primarily employs first-period lagged digital transformation data as the new explanatory variable. The development of new quality productivity is inherently a long-term process, and the impact of corporate digital transformation may exhibit lag effects. To account for this potential influence and test the lag level, the paper incorporates the first-period lagged digital transformation

(Indigg) into the regression model. The results are presented in **Table 4**: Column (1) shows the autoregressive coefficient of digital transformation (Indigg) without control variables, which is 0.167 and statistically significant at the 1% level. Column (2) presents the regression coefficients of various control variables on new quality productivity when excluding the explanatory variable Indigg. Column (3) demonstrates the regression results after adding control variables, where the coefficient of digital transformation on new quality productivity is 0.130 and remains significant at the 1% level. The positive coefficient in **Table 4** indicates that even after controlling for endogeneity through first-period lagged explanatory variables, digital transformation still significantly enhances new quality productivity. This finding aligns with the baseline regression conclusions and further validates Hypothesis 1.

## 5. Threshold Effect

The relationship between digital transformation and the level of new-type productivity in enterprises is influenced by the quality of the business environment in their respective regions. Specifically, the impact of digital transformation on the development of new-type productivity may vary depending on the specific business environment conditions. To further examine how digital transformation affects new-type productivity under different business environments, this study employs the Stata 17.0 statistical software. Using a threshold effect model, we categorize the business environment into three scenarios based on 3745 panel data observations from specialized, refined, distinctive, and innovative enterprises nationwide, conducting threshold regression tests. We estimate the effects for three scenarios: no threshold, one threshold, and two thresholds. Through 1000 repeated sampling iterations, we derive the p-values required for statistical testing, which further determine the presence of threshold effects. **Figure 1** presents the single-threshold likelihood ratio function graph of the business environment, which more clearly illustrates the threshold value and confidence interval within this business environment. After deriving the threshold value through the single-threshold effect model, this study further conducts parameter estimation of the threshold model. The results demonstrate that the impact of digital transformation on enterprises' new-type productivity varies across different levels of business environment. Specifically, when the business environment level exceeds the threshold value, the promotion effect of digital transformation on new-type productivity shows a significant leap, transitioning from no significant impact to a statistically significant positive effect at the 1% level. This indicates that the business environment must reach a critical threshold for the enhancement effect of digital transformation on new-type productivity to be effectively amplified, thereby validating Hypothesis H2. Through the aforementioned analysis, it is found that a lower-level business environment increases uncertainty in corporate digital transformation, thereby exacerbating the risk of value conversion and preventing significant impact on the development of new-type productivity.



**Figure 1.** Example of a figure caption (figure caption).

## 6. Conclusions and Implications

This study utilizes panel data from China's specialized, refined, distinctive, and innovative (SRDI) A-share listed companies between 2018 and 2022 as its research subject. It primarily explores the relationship between digital transformation and the development of enterprises' new-quality productivity, examines the impact of digital transformation on enterprises' new-quality productivity levels, and further employs a threshold effect model to investigate the nonlinear influence and constraint mechanisms of business environment on this relationship. The research conclusions indicate: First, digital transformation can significantly and positively promote the improvement of enterprises' new-quality productivity levels. Second, although digital transformation generally benefits the enhancement of new-quality productivity levels, this positive effect exhibits an implicit threshold effect under different levels of business environment. In low-level business environments, the promoting effect of digital transformation on new-quality productivity is not significant; only when the business environment reaches a certain level does this effect become pronounced. The above conclusions have passed a one-period lag robustness test, demonstrating their credibility. Based on these findings, the paper proposes the following policy implications:

First, under the digital China vision and the goal of accelerating the development of new-quality productivity, efforts should be intensified to enhance enterprises' digital transformation capabilities. The government should actively introduce a series of policies related to digital transformation to provide enterprises with clear and defined directions for digital transformation, while encouraging them to actively engage in digital transformation. At the financial level, the government can also establish special grant funds for digital transformation, offering

financial support through fiscal subsidies and tax reductions to willing enterprises during their digital transformation process, thereby alleviating their financial pressure. At the technological level, the government can encourage enterprises to collaborate with research institutions and universities on technology exchange, jointly promote technological innovation and R&D, leverage the advantages of high-level talent, and help relevant enterprises master core technologies, thereby enhancing their own level of digital transformation. Secondly, heterogeneity analysis reveals significant regional disparities in how digital transformation impacts enterprises' enhancement of new-type productivity levels. Enterprises in regions with underdeveloped digital infrastructure should seize digital transformation opportunities, leverage technological advantages to boost productivity, and narrow the gap with industry leaders. Meanwhile, governments should intensify support for businesses in central and western regions with limited digital infrastructure, expand innovation collaboration channels, and promote digital transformation through a "strong leading weak" model. This approach will help establish a comprehensive digital ecosystem, collectively driving improvements in enterprise productivity. Thirdly, governments must continue to optimize the market business environment, refine governance frameworks for digital economy and digital technologies, and actively empower enterprises to enhance their new-type productivity levels. Efforts should focus on addressing critical bottlenecks and obstacles that hinder digital transformation-driven productivity upgrades. Simultaneously, it is essential to foster the development of proactive governance and efficient markets, enabling digital transformation to fully demonstrate its unique advantages in enterprise development. This approach will ultimately drive significant improvements in corporate productivity capabilities.

### Conflicts of Interest

The authors declare no conflicts of interest.

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