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The Impact of Enterprise Participation in Digital Technology Standard Setting on New Quality Productivity: Evidence from Chinese Listed Firms

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Abstract: This paper investigates the impact of enterprise participation in digital technology standard setting on firms' new quality productive forces using Chinese A-share listed companies from 2012 to 2025. The results show that enterprise participation in digital technology standard setting significantly enhances firms' new quality productive forces. Mechanism analysis indicates that this effect is achieved by improving digital innovation capability and digital resource allocation efficiency. Further heterogeneity analysis reveals that the effect is more pronounced among firms participating in industry-level digital technology standards, high-tech firms, and firms with higher levels of data assets.

Keywords: Digital technology standard-setting participation; New quality productive forces; Digital innovation capability; Digital resource allocation efficiency.

1. Introduction

With the new round of technological revolution and industrial transformation, developing new quality productive forces has become an important pathway for China to achieve technological self-reliance and self-strengthening. Existing studies show that technological innovation capability is a key driver of new quality productive forces development (Wang et al., 2026). As an important dimension of innovation capability, digitalization has been widely studied, with evidence showing that it can enhance enterprise resilience (Wang et al., 2025). However, limited attention has been paid to whether enterprise participation in digital technology standard setting can promote firms' new quality productive forces. Such participation enables firms to obtain technological influence and strategic advantages in emerging digital fields, but micro-level evidence on its economic consequences remains scarce. Therefore, this study examines the impact of enterprise participation in digital technology standard setting on firms' new quality productive forces.

Against the background of increasing technological competition, participation in digital technology standard setting has become an important strategy for firms to strengthen technological advantages. By engaging in standard setting, firms can obtain information on technological trends and future development directions earlier (Long and Zhang, 2023), thereby improving innovation decisions and productivity. Existing studies find that participation in technical standard setting promotes technological innovation and improves market performance (Wu and de Vries, 2022), suggesting that digital technology standard-setting participation may contribute to firms' new quality productive forces.

However, existing literature has rarely examined the differentiated effects of standard-setting participation in specific technological fields. Compared with traditional standards, digital technology standards integrate digital technologies and systems and can be embedded into enterprise information governance processes (Sturgeon, 2021), thereby affecting firms' technological development and resource utilization. This paper investigates the impact of enterprise participation in digital technology standard setting and identifies two mechanisms: digital innovation capability and digital resource allocation efficiency. Using Chinese A-share listed firms from 2012 to 2025, this study employs a two-way fixed effects model for empirical analysis. This study contributes by extending research on the economic consequences of standard-setting participation, providing micro-level evidence on its impact on new quality productive forces, and revealing the roles of digital innovation capability and resource allocation efficiency.

2. Theoretical Analysis and Research Hypotheses

2.1. Enterprise Participation in Digital Technology Standard Setting and New Quality Productive Forces

Enterprise participation in digital technology standard setting is closely associated with the development of firms' new quality productive forces. Existing studies show that participation in technical standard setting can improve firm productivity (Hou et al., 2020). By participating in digital technology standard setting, firms can obtain technological knowledge, identify emerging technology trends, and reduce uncertainty in innovation decisions. Furthermore, technological standardization can promote innovation in the digital industry (Qi and Zhu, 2023). Therefore, participation in digital technology standard setting helps firms accumulate technological advantages and improve innovation efficiency, thereby enhancing their new quality productive forces. This study proposes the following hypothesis:

H1: Enterprise participation in digital technology standard setting positively affects firms' new quality productive forces.

2.2. The Mechanism of Digital Innovation Capability

Enterprise participation in digital technology standard setting can enhance digital innovation capability through knowledge exchange and collaborative networks. By participating in standard-setting activities, firms can access advanced technological knowledge and strengthen cooperation with other innovation actors (Xu et al., 2025), thereby promoting digital technology innovation. Meanwhile, digital innovation capability is an important foundation for improving firms' new quality productive forces (Wang et al., 2026). Therefore, enterprise participation in digital technology standard setting may enhance new quality productive forces by improving digital innovation capability.

H2: Enterprise participation in digital technology standard setting enhances firms' new quality productive forces by improving digital innovation capability.

2.3. The Mechanism of Digital Resource Allocation Efficiency

Enterprise participation in digital technology standard setting may improve digital resource allocation efficiency by promoting data interoperability, information sharing, and system integration. Digital technology standards provide common technical frameworks and interface specifications, which can reduce the costs of accessing external digital resources and alleviate information asymmetry among firms. Improved digital resource allocation efficiency enables firms to better integrate and utilize digital resources, thereby enhancing new quality productive forces (Fu, 2024).

H3: Enterprise participation in digital technology standard setting enhances firms' new quality productive forces by improving digital resource allocation efficiency.

3. Research Design

3.1. Sample Selection and Data Sources

This study uses Chinese A-share listed firms from 2012 to 2025 as the initial sample. The sample is processed as follows: (1) excluding firms in the financial and real estate industries; (2) excluding ST, *ST, and PT firms; and (3) excluding observations with missing key variables. Continuous variables are winsorized at the 1% and 99% levels to reduce the influence of extreme values. After these procedures, 34,264 firm-year observations are obtained. Data are mainly collected from the CSMAR database, including financial information, corporate governance characteristics, and firm fundamentals. Data on digital technology standard-setting participation and digital transformation-related indicators are obtained from the Chinese Research Data Service Platform (CNRDS).

3.2. Variable Description

(1) Dependent Variable. Enterprise New Quality Productivity (NQP) is constructed based on Xu et al. (2025). Following this study, NQP is measured from four dimensions: new quality labor force, new quality labor materials, new quality labor objects, and optimized combinations. Specifically, the indicators include R&D personnel proportion, highly educated employee proportion, R&D investment intensity, digital asset proportion, invention patents, data resource stock, total factor productivity, and data-driven capability. A comprehensive index is constructed based on these indicators, and NQP_norm is used as an alternative measure in the robustness test.

(2) Independent Variable. Digital Technology Standard Setting (Digstd) is constructed based on Cao (2026). It is measured by the logarithm of the cumulative number of times an enterprise participates in national and industry digital technology standard setting over the previous five years plus one. Digital technology standards are identified based on standard classification codes and digital-related keywords in standard names.

(3) Control Variables. This study controls for Enterprise Size (Size), Ownership (SOE), Debt Ratio (Lev), Return on Assets (ROA), Proportion of Independent Directors (Indep_Dir), Regional GDP Growth Rate (GDP_growth), Industry Competition Degree (HHI), Growth (Growth), and Capital Intensity (CI). Detailed measurements of these variables are provided as follows: Size is measured by the natural logarithm of total assets; SOE is a dummy variable; Lev is measured by total liabilities divided by total assets; ROA is measured by net profit divided by total assets; Indep_Dir is measured by the proportion of independent directors; GDP_growth represents regional GDP growth; HHI is calculated based on industry-year concentration; Growth is measured by revenue growth; and CI is measured by the ratio of net fixed assets to total assets.

(4) Mechanism Variables. Digital Technology Innovation Capability (DTI) is measured by the logarithm of digital technology-related invention patent applications, following Hu and Ma (2023). Digital Resource Optimization Allocation (DRA) is constructed based on data element utilization and innovation resource allocation efficiency.

3.3. Model Construction

To test the impact of enterprise participation in digital technology standard setting on enterprises' new quality productive forces, this study constructs a two-way fixed effects model including industry and year fixed effects, with robust standard errors clustered at the firm level.

4. Empirical Results

4.1. Descriptive Statistics

Table 1 presents the descriptive statistics of the main variables. The mean of Enterprise New Quality Productivity (NQP) is -0.027, with a standard deviation of 1.014, indicating substantial variation in NQP among firms. The mean value of Digital Technology Standard Setting (Digstd) is 0.089, indicating that firms' participation in digital technology standard setting is relatively limited during the sample period. The remaining variables also exhibit certain degrees of variation, providing a basis for subsequent regression analysis.

Table 1. Descriptive Statistics

Variable	N	Mean	SD	Min	Max
NQP	34264	-0.027	1.014	-1.549	3.747
Digstd	34264	0.089	0.294	0.000	1.609
DTI	34264	1.332	1.378	0.000	5.442
DRA	34264	0.013	0.862	-0.622	4.684
MP_support	34264	0.552	0.497	0.000	1.000
Size	34264	22.286	1.258	20.111	26.212
SOE	34264	0.267	0.442	0.000	1.000
Lev	34264	0.406	0.200	0.058	0.900
ROA	34264	0.030	0.070	-0.285	0.196
Indep_Dir	34264	3.086	0.502	2.000	5.000
GDP_growth	34264	6.908	3.587	0.674	15.538
HHI	34264	0.075	0.082	0.013	0.501
Growth	34264	0.296	0.816	-0.802	2.383
CI	34264	0.198	0.143	0.003	0.638

4.2. Baseline Regression

The results of the baseline regression are presented in Table 2. Column (1) excludes control variables, and the coefficient of Digstd is 0.930, which is significantly positive at the 1% level. Column (2) introduces control variables, and the coefficient of Digstd remains positive and significant. Column (3) further controls for industry and year fixed effects, and the coefficient of Digstd remains significantly positive . The results indicate that enterprise participation in digital technology standard setting significantly improves firms' NQP after controlling for different model specifications. Therefore, H1 is supported.

Table 2. Baseline Regression Analysis

	(1)	(2)	(3)
	NQP	NQP	NQP
Digstd	0.930***	0.779***	0.340***
	(0.022)	(0.021)	(0.042)
Size		0.057***	0.116***
		(0.005)	(0.010)
SOE		-0.086***	-0.005
		(0.012)	(0.025)
Lev		-0.867***	-0.584***
		(0.033)	(0.060)
ROA		-1.704***	-0.743***
		(0.089)	(0.128)
Indep_Dir		0.035***	0.041**
		(0.011)	(0.019)
GDP_growth		-0.015***	0.002
		(0.001)	(0.003)
HHI		-1.936***	-0.505***
		(0.063)	(0.182)
Growth		0.043***	0.001
		(0.006)	(0.006)
CI		-2.180***	-1.390***
		(0.035)	(0.079)
_cons	-0.110***	-0.382***	-2.203***
	(0.005)	(0.103)	(0.210)
Industry/Yea	No	No	Yes
N	34264	34264	34264
ar2	0.073	0.229	0.467

Note: ***, **, * indicate significance at the 1%, 5%, and 10% levels respectively. The values in parentheses represent the two-tailed t-values corresponding to the robust standard errors at the company-level clustering, and the same applies below.

4.3. Robustness Test

To further verify the reliability of the baseline results, this study conducts several robustness tests, including alternative variable measurement, lagged explanatory variables, propensity score matching (PSM), placebo tests, and endogeneity tests.

First, NQP_norm is used as an alternative measure of NQP. As shown in Column (1) of Table 3, the coefficient of Digstd remains significantly positive, indicating that the baseline findings are robust. Second, considering potential reverse causality, the one-period lagged value of Digstd (L.Digstd) is introduced. The results in Column (2) remain significantly positive, suggesting that the findings are not driven by reverse causality. Third, the PSM method is applied to reduce possible sample selection bias. As shown in Column (3), the positive effect of Digstd remains significant after matching.

Fourth, a placebo test is conducted by randomly assigning the explanatory variable. The results show that the estimated coefficients are insignificant, indicating that the baseline results are unlikely to be driven by random factors. Finally, an endogeneity test is conducted, and the results remain consistent with the baseline regression, further confirming that enterprise participation in digital technology standard setting positively affects firms' NQP. Overall, the robustness tests support the reliability of the baseline conclusions.

Table 3. Results of Robustness Test

	(1)	(2)	(3)	(4)
	Replace the explained variable	Replace the explanatory variable	Exclude the municipalities directly under the central government	Excluding 2020
	NQP_norm	NQP	NQP	NQP
DTS_digital_national_dummy	0.325***	0.325***		
	(0.052)	(0.052)		
Size	0.130***	0.130***	0.104***	0.118***
	(0.010)	(0.010)	(0.011)	(0.010)
SOE	0.007	0.007	0.002	-0.006
	(0.026)	(0.026)	(0.027)	(0.025)
Lev	-0.593***	-0.593***	-0.388***	-0.591***
	(0.060)	(0.060)	(0.060)	(0.060)
ROA	-0.784***	-0.784***	-0.442***	-0.790***
	(0.128)	(0.128)	(0.130)	(0.130)
Indep_Dir	0.043**	0.043**	0.044**	0.040**
	(0.019)	(0.019)	(0.020)	(0.019)
GDP_growth	0.002	0.002	0.002	0.004
	(0.003)	(0.003)	(0.003)	(0.003)
HHI	-0.529***	-0.529***	-0.490**	-0.489***
	(0.182)	(0.182)	(0.197)	(0.187)
Growth	0.001	0.001	-0.003	0.002
	(0.006)	(0.006)	(0.006)	(0.006)
CI	-1.427***	-1.427***	-1.276***	-1.385***
	(0.079)	(0.079)	(0.082)	(0.079)
Digstd			0.356***	0.335***
			(0.050)	(0.042)
_cons	-2.495***	-2.495***	-2.141***	-2.267***
	(0.214)	(0.214)	(0.227)	(0.209)
Industry/Year	Yes	Yes	Yes	Yes
N	34264	34264	27750	31148
ar2	0.461	0.461	0.438	0.465

4.4. Mechanism Verification

Enterprise participation in digital technology standard setting may enhance firms' NQP through digital innovation capability and digital resource optimization allocation. Specifically, participation in digital technology standard setting facilitates knowledge exchange and improves firms' ability to develop and utilize digital technologies, while also promoting data resource utilization and allocation efficiency.

Table 4 reports the mechanism test results. Column (1) shows that the coefficient of Digstd on DTI is 0.298 and significant at the 1% level, indicating that enterprise participation in digital technology standard setting improves digital innovation capability. Column (2) shows that the coefficient of DTI on NQP is 0.251 and significant at the 1% level, suggesting that DTI is an important channel through which Digstd affects NQP. Therefore, H2 is supported. Columns (3) and (4) examine the role of DRA. The coefficient of Digstd on DRA is 0.473 and significant at the 1% level, while the coefficient of DRA on NQP is 0.408 and significant at the 1% level. These results indicate that enterprise participation in digital technology standard setting improves NQP by enhancing digital resource optimization allocation, supporting H3.

Table 4. Mechanism Verification

	(1)	(2)	(3)	(4)
	DTI	NQP	DRA	NQP
Digstd	0.298***	0.265***	0.473***	0.147***
	(0.074)	(0.039)	(0.061)	(0.036)
Size	0.250***	0.053***	0.242***	0.017*
	(0.019)	(0.009)	(0.017)	(0.010)
SOE	-0.043	0.006	-0.137***	0.051**
	(0.043)	(0.023)	(0.026)	(0.024)
Lev	-0.193**	-0.535***	-0.224***	-0.492***
	(0.087)	(0.054)	(0.052)	(0.054)
ROA	1.938***	-1.229***	-0.615***	-0.492***
	(0.166)	(0.117)	(0.115)	(0.115)
Indep_Dir	0.070**	0.024	0.048**	0.022
	(0.033)	(0.017)	(0.020)	(0.017)
GDP_growth	0.005	0.001	-0.001	0.002
	(0.005)	(0.003)	(0.003)	(0.003)
HHI	-0.510**	-0.378**	-0.052	-0.484***
	(0.258)	(0.166)	(0.143)	(0.176)
Growth	-0.086***	0.022***	-0.007	0.004
	(0.011)	(0.006)	(0.007)	(0.006)
CI	-0.126	-1.358***	-0.456***	-1.203***
	(0.125)	(0.072)	(0.075)	(0.072)
DTI		0.251***		
		(0.007)		
DRA				0.408***
				(0.018)
_cons	-4.392***	-1.102***	-5.329***	-0.028
	(0.412)	(0.191)	(0.354)	(0.206)
Industry/Year	Yes	Yes	Yes	Yes
N	34264	34264	34264	34264
ar2	0.212	0.558	0.356	0.544

4.5. Heterogeneity Analysis

Table 5 presents the heterogeneity analysis of the impact of enterprise participation in digital technology standard setting on firms' NQP. The analysis is conducted from three perspectives: standard type, industry attribute, and data asset scale.

(1) Standard type. The coefficients of Digstd_gb, Digstd_hb, and Digstd are 0.338, 0.495, and 0.340, respectively, all significant at the 1% level. The results indicate that participation in industry-level digital technology standard setting has a stronger effect than participation in national-level standards. This may be because industry-level standards are more closely related to firms' specific business practices and application scenarios. In contrast, firms not participating in either type of digital technology standard setting show a significantly negative coefficient, further highlighting the importance of standard-setting participation.

(2) Industry attribute. The coefficients of Digstd are 0.347 and 0.274 for high-tech and non-high-tech firms, respectively, both significant at the 1% level. The results suggest that the effect of enterprise participation in digital technology standard setting is stronger among high-tech firms, possibly because these firms possess stronger digital foundations and technological application capabilities.

(3) Data asset scale. The coefficient of Digstd is 0.367 for firms with high data assets and 0.043 for firms with low data assets. The former is significant at the 1% level, while the latter is insignificant. This indicates that firms with richer data assets benefit more from participation in digital technology standard setting, as they may have stronger capabilities to absorb and transform external knowledge into productivity improvements.

Table 5. Heterogeneity Test

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Standard type				Industry attribute		Data asset scale	
	Only participate in national digital technology standards	Only participate in industry digital technology standards	Both digital technology standards were involved	Neither of the two digital technology standards is involved.	High-tech industry	Non-high-tech industries	High data assets	Low data assets
Digstd_gb	0.338***							
	(0.049)							
Size	0.120***	0.125***	0.116***	0.119***	0.155***	0.083***	0.129***	0.043***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.016)	(0.013)	(0.014)	(0.012)
SOE	-0.001	0.003	-0.005	-0.001	0.035	-0.066**	-0.007	0.044*
	(0.025)	(0.025)	(0.025)	(0.025)	(0.040)	(0.030)	(0.038)	(0.027)
Lev	-0.588***	-0.583***	-0.584***	-0.583***	-0.603***	-0.594***	-0.856***	-0.268***
	(0.060)	(0.060)	(0.060)	(0.060)	(0.092)	(0.074)	(0.092)	(0.057)
ROA	-0.760***	-0.756***	-0.743***	-0.748***	-1.061***	-0.556***	-1.055***	-0.118
	(0.128)	(0.128)	(0.128)	(0.128)	(0.203)	(0.162)	(0.183)	(0.145)
Indep_Dir	0.043**	0.041**	0.041**	0.042**	0.032	0.040*	0.041	0.031*
	(0.019)	(0.019)	(0.019)	(0.019)	(0.030)	(0.024)	(0.027)	(0.018)
GDP_growth	0.002	0.002	0.002	0.002	-0.001	0.005	-0.000	0.005*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.004)	(0.005)	(0.003)
HHI	-0.518***	-0.507***	-0.505***	-0.515***	0.331	-0.814***	-0.275	-0.458**
	(0.182)	(0.183)	(0.182)	(0.182)	(0.313)	(0.234)	(0.281)	(0.221)
Growth	0.001	0.002	0.001	-0.000	-0.019*	0.015**	0.010	-0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.010)	(0.008)	(0.009)	(0.007)
CI	-1.403***	-1.409***	-1.390***	-1.397***	-2.434***	-0.534***	-1.599***	-0.923***
	(0.079)	(0.078)	(0.079)	(0.079)	(0.127)	(0.092)	(0.122)	(0.075)
Digstd_hb		0.495***						
		(0.073)						
Digstd			0.340***		0.347***	0.274***	0.367***	0.043
			(0.042)		(0.057)	(0.058)	(0.046)	(0.050)
none_std				-0.302***				
				(0.038)				
_cons	-2.295***	-2.383***	-2.203***	-1.975***	-2.761***	-1.695***	-2.033***	-1.167***
	(0.211)	(0.210)	(0.210)	(0.219)	(0.317)	(0.267)	(0.282)	(0.244)
Industry/Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	34264	34264	34264	34264	15754	18510	17130	17131
adj. R2	0.465	0.465	0.467	0.465	0.354	0.558	0.461	0.291

5. Conclusion and Implications

Based on the data of Shanghai and Shenzhen A-share listed companies from 2012 to 2025, this study employs a two-way fixed effects model to examine the impact of enterprise participation in digital technology standard setting on firms' new quality productivity. The results show that enterprise participation in digital technology standard setting significantly improves firms' NQP, and the findings remain robust after multiple robustness checks, placebo tests, and endogeneity tests. Mechanism analysis indicates that this effect is achieved by improving digital technology innovation capability and optimizing digital resource allocation. Heterogeneity analysis reveals that the effect is more pronounced among firms participating in industry-level digital technology standards, high-tech firms, and firms with higher data assets.

Based on these findings, enterprises should consider participation in digital technology standard setting as an important strategy for enhancing technological advantages and NQP. By actively participating in standard-setting activities, firms can better capture technological trends, strengthen digital innovation capability, and improve resource utilization efficiency. Meanwhile, enterprises should enhance investment in digital innovation and improve data resource utilization and allocation mechanisms to promote the development of new quality productive forces.

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