Proceedings of EKONBIZ 2026
ISBN: 978-99955-45-52-9
UDK: 005.311.11:658.012.1(100)

Submitted: 03.04.2026.
Accepted: 01.06.2026.
Original Article

HOW DOES STANDARDIZATION AFFECT THE QUALITY OF CORPORATE INNOVATION?

Youran Wu
School of Economics & Management, Shanghai Polytechnic University, China
1615695484@qq.com
ORCID: 0009-0002-6506-6249

Li Yao
School of Economics & Management, Shanghai Polytechnic University, China
yaoli@sspu.edu.cn
ORCID: 0000-0002-7925-0103

Abstract: *Using the National Comprehensive Standardization Reform Pilot Program as a quasi-experimental framework, this study employs a multi-period difference-in-differences model based on data from Chinese A-share listed companies from 2010 to 2024 to examine the impact of standardization efforts on the quality of corporate innovation and its underlying mechanisms.The study finds that standardization significantly improves the quality of corporate innovation, a conclusion that holds up after a series of tests. Mechanism tests indicate that standardization promotes improvements in the quality of corporate innovation through two pathways: enhancing resource allocation efficiency and increasing managers' attention to innovation. Heterogeneity analysis reveals that this effect is more pronounced in regions with higher marketization levels, technology-intensive industries, and private enterprises. This paper offers a new perspective on understanding the micro-institutional spillover effects of standardization..*

Key words*: Standardization initiatives, firm innovation quality, National Comprehensive Standardization Reform Pilot Program, resource allocation efficiency, managerial focus on innovation.*

JEL classification*: O32, O33, L15*

1. INTRODUCTION

The 14th Five-Year Plan period is a critical stage for China as it moves toward the goal of basically achieving socialist modernization by 2035. As an integral part of the country's foundational institutional framework, standardization has been incorporated into the national top-level strategic design. The National Standardization Development Outline explicitly states that mechanisms for transforming scientific and technological achievements into standards must be improved, and that the interactive development of standards and technological innovation must be promoted, with standardization playing a more effective role in enhancing the country's comprehensive competitiveness by 2035. This series of policy signals indicates that standardization has evolved from the traditional formulation of technical specifications into a foundational institutional arrangement within the national innovation system. Against this backdrop, comprehensive national standardization reform pilot programs have been successively implemented in provinces such as Zhejiang, Shanxi, Jiangsu, Shandong, and Guangdong since 2016, aiming to optimize the governance structure of standardization and facilitate the smooth flow of technological factors.

At the same time, as a foundational institutional arrangement in the modern economic system, the economic implications of standards have attracted widespread attention in academic circles.Globally, the combined positive contribution of standards, conformity assessment, and accreditation systems to GDP accounts for approximately 7%–8% of GDP in developed economies (Blind et al., 2026). In contrast, calculations by the China National Institute of Standardization indicate that the direct contribution of standardization to China's economy is approximately 1.16%. This gap reflects both the objective disparity between China's standardization level and that of developed countries and signifies that China's standardization efforts still have significant room for improvement.Existing literature has extensively explored the economic implications of standardization efforts, research based on the national comprehensive standardization reform pilot program as a natural experiment demonstrates that standardization efforts significantly enhance

corporate patent transactions by reducing institutional transaction costs and boosting enterprises' focus on innovation (Hao & Ye, 2024). At the urban level, standardization governance initiatives exemplified by this reform have likewise markedly increased entrepreneurial activity, with technological innovation clustering and public service optimization serving as key transmission mechanisms (An & Chen, 2025). However, research perspectives have largely focused on economic benefits or the quantity of innovation, with relatively limited attention paid to innovation quality.In practice, many firms engage in strategic innovation behavior that "prioritizes quantity over quality," resulting in a prominent patent bubble phenomenon. Innovation policies exert a stronger incentive effect on the quantity of corporate innovation than on its quality, leading to a certain imbalance between quantity and quality (Yuan et al., 2020). How to resolve the patent allocation dilemma faced by firms and improve innovation quality through standardization has become a critical issue in the current deepening of science and technology system reform.

This paper treats the National Comprehensive Standardization Reform Pilot Program as a quasi-natural experiment. Using data from Chinese A-share listed companies from 2010 to 2024 and employing a multi-period difference-in-differences model, we examine the impact of standardization efforts on corporate innovation quality and its underlying mechanisms. The marginal contributions of this study are as follows: First, it expands the research perspective from innovation quantity to innovation quality. Second, it reveals the underlying mechanisms from both resource and cognitive perspectives; the comprehensive standardization reform pilot policies not only directly affect corporate innovation quality but, more importantly, generate a lasting and stable innovation-driven effect by reshaping internal resource allocation and optimizing managers' strategic cognition. Third, the quasi-natural experiment design based on large-scale microdata provides reliable support for policy evaluation.

2. RESEARCH OBJECTIVES AND METHODS

(I) Research Objectives

This paper aims to achieve the following research objectives: First, to empirically test the causal effect of standardization initiatives on enterprise innovation quality; second, to identify two mechanisms—resource allocation efficiency and managerial focus on innovation; third, to explore the heterogeneous manifestations of this effect across three dimensions: property rights characteristics, regional marketization levels, and industry factor intensity.

(2) THEORETICAL ANALYSIS AND RESEARCH HYPOTHESES

1. Resource Allocation Efficiency Mechanism

According to signaling theory, the national pilot program for comprehensive standardization reform sends a positive signal that the government is committed to advancing standardization governance, thereby helping to strengthen firms' stable expectations regarding the future policy environment (An & Chen, 2025). At the same time, standardization efforts unify technical standards and regulate market order, reducing administrative intervention by local governments in factor markets, curbing inefficient and excessive investment by firms, and freeing up innovation resources that were previously tied up.Technical standards help alleviate distortions in capital and labor factors, improve resource misallocation, and enhance resource allocation efficiency in the manufacturing sector. Based on this, we propose Hypothesis H1: Standardization efforts promote improvements in the quality of enterprise innovation by enhancing resource allocation efficiency.

2. The Mechanism of Managerial Attention to Innovation

According to the attention-based perspective, the attention of corporate executives is a scarce resource. In environments with low standardization, managers must expend significant effort navigating inconsistent market rules and complex government-enterprise relationships. Standardization, by clarifying technological development directions and unifying industry technical specifications, reduces uncertainty regarding technological choices and institutional responses. This frees managers' limited attention from the process of groping for direction, allowing them to focus more intently on innovation-related issues such as R&D management and breakthroughs in core technologies.Research indicates that the innovation focus of senior management teams significantly positively impacts corporate innovation performance. Companies with higher innovation focus demonstrate superior both quantity and quality in their patent applications (Wang et al., 2023).Based on this, we propose Hypothesis H2: Standardization promotes improvements in corporate innovation quality by enhancing managers' attention to innovation.

To test the above hypothesis, this study employs a multi-period difference-in-differences model, specified as follows:

$$KnowDiv_{it}=\beta_0+\beta_1 Policy_{it}+\beta_2 X_{it}+\mu_i+v_i+\epsilon_{it} \quad (1)$$

where i represents the firm and t represents the year; $KnowDiv_{it}$ represents firm innovation quality; $Policy_{it}$ is the core explanatory variable, taking a value of 1 if the firm is located in a pilot province and the reform has been implemented, and 0 otherwise; X_{it} is a set of control variables that may influence the firm's foreign direct investment; μ_i *and* v_t are the firm-level and year-level fixed effects, respectively; ϵ_{it} represents the regression residual; furthermore, to mitigate the effects of serial correlation and heteroskedasticity, all regression standard errors are adjusted for firm-level clustering.

(4) Variable Selection and Data Description

1. Dependent Variable: Firm Innovation Quality

A review of existing literature reveals that measurements of corporate innovation quality primarily focus on three indicators: citation frequency of patents, the number of invention patent applications, and knowledge breadth calculated based on patent classification numbers. However, both patent quantity and citation frequency exhibit systematic biases as innovation measurement tools, and these biases are often difficult to mitigate using conventional adjustment methods when aggregated at the firm level. Drawing on prior research on corporate innovation quality (Li et al., 2021), this paper employs Patent Knowledge Breadth to measure corporate innovation quality. Patent knowledge breadth reflects the complexity and breadth of the knowledge embedded in patents. It effectively avoids the shortcomings of using patent quantity alone to measure innovation output, more accurately captures the substantive quality of firm innovation (Zhang & Zheng, 2018), and better reflects a firm's core competitiveness and long-term development potential. The methodology for calculating patent knowledge breadth is as follows: First, based on the patent database of the China National Intellectual Property Administration, we obtain the IPC classification codes for the invention patents and utility model patents filed by firms each year.The IPC patent classification format used in China is "Section – Class – Subclass – Division – Group," such as "A03 B03/00." Specifically, the first letter of the classification code represents one of eight main sections: Section A: Necessities of Life (Agriculture, Light Industry, Medicine); Section B: Industry, Transport; Section C: Chemistry, Metallurgy; Section D: Textiles, Paper; Section E: Fixed Structures; Section F: Mechanical Engineering, Lighting, Heating, Weapons, Explosives; Section G: Physics; Section H: Electrical Engineering), the second and third digits denote the class, and the fourth letter denotes the subclass.The "/" serves as the separator between major and minor categories, with the category preceding it representing the major category and the one following it representing the minor category. Considering that relying solely on classification code information makes it difficult to accurately distinguish technical differences within patents, this paper draws on the approach used to measure industrial concentration and applies a weighting process based on the Herfindahl–Hirschman Index (HHI) at the major category level. The specific measurement method is as follows:

$$KnowDiv_{it}=1-\sum\left(\frac{Z_{mit}}{Z_{it}}\right)^2$$

where Z_{mit} represents the cumulative number of invention and utility model patents filed by firm i under the mth IPC major group as of year t, and Z_{it} denotes the total number of patents filed by firm i across all major groups as of year t (Li et al., 2021). A higher value indicates that the patents cover a broader range of technical fields, possess higher knowledge complexity, and reflect better innovation quality.

2. Explanatory Variable: Standardization Development ($Policy_{it}$)

Regarding the measurement of the core explanatory variable, standardization policy ($Policy_{it}$), this study employs a multi-period difference-in-differences model, setting $Policy_{it}$as a policy dummy variable.Following the methodology of Hao and Ye (2024), the specific assignment rules are as follows: If the registered office of a sample firm is located in a province designated as a national comprehensive standardization reform pilot, and the time period falls after the province officially launched the pilot reform, then $Policy_{it}$is set to 1; otherwise, it is 0.Based on the implementation timelines of each province's pilot program, this study assigns a value of 1 to firms registered in Zhejiang Province for samples from 2017 onward, and to firms registered in Shanxi, Jiangsu, Shandong, and Guangdong Provinces for samples from 2018 onward; all other samples are assigned a value of 0.

3. Control Variables

Including enterprise scale (Size), asset - liability ratio (Lev), return on assets (ROA), cash flow ratio (CashFlow), operating revenue growth rate (Growth), equity concentration (Top1), board size (Board), and enterprise age (ListAge).

4. Data Description

This study uses Chinese A-share listed companies from 2010 to 2024 as the initial sample, excluding financial and ST-listed companies, and applies a two-sided 1% trim-and-fill procedure to continuous variables. Patent data is sourced from the China National Intellectual Property Administration, and financial data is sourced from the CSMAR database. A total of 39,002 firm-year observations were ultimately obtained. Descriptive statistics are presented in Table 1

Table 1: Descriptive statistics for the main variables

Type of variable	Variable name	Sample size	Mean	Standard deviation	Minimum	Maximum
Explained variable	KnowDiv	39002	0.9404	0.082	0.4444	0.9997
Core explanatory variable	Policy	39002	0.4572	0.498	0.0000	1.0000
Control variable	Size	39002	22.3111	1.300	20.0798	26.4008
	Lev	39002	0.4205	0.201	0.0563	0.8868
	ROA	39002	0.0315	0.064	-0.2496	0.1937
	CashFlow	39002	0.0465	0.065	-0.1419	0.2328
	Growth	39002	0.1366	0.337	-0.5321	1.8436
	Top1	39002	0.3322	0.147	0.0803	0.7356
	Board	39002	2.1121	0.198	1.6094	2.6391
	ListAge	39002	2.1613	0.780	0.6931	3.4012

Source: authors

3.RESULTS

(1) Baseline Regression

Table 2 reports the results of the baseline regression. Column (1) includes only the explanatory variables and fixed effects; the coefficient for Policy is 0.0042, which is significant at the 1% level. In Column (2), after adding all control variables, the coefficient for Policy is 0.0039, which remains significant at the 1% level. This indicates that standardization efforts significantly improve the quality of corporate innovation, and the hypothesis is preliminarily validated

Table 2. The Impact of National Standardization on Firm Innovation Quality: Baseline Regression

	(1) Knowledge Breadth of Patent Applications	(2) Knowledge breadth of patent applications
Policy	0.0042***	0.0039***
	(2.8490)	(2.6710)
Control variables	No	Yes
Firm fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Number of observations	39,002	39,002
Adjusted R^2	0.5131	0.5344

*Note: The values in parentheses are t-values clustered at the firm level; ***, **, and *indicate significance levels of 1%, 5%, and 10%, respectively*

Source: authors

(2) Validity Tests

1. Parallel Trends Test

Ensuring the unbiasedness of the difference-in-differences estimates hinges on satisfying the parallel trends assumption, i.e., it must be demonstrated that prior to the implementation of the national standardized comprehensive reform pilot policy, the changes in innovation quality for firms in pilot and non-pilot regions followed the same temporal trends. The model is specified as follows:

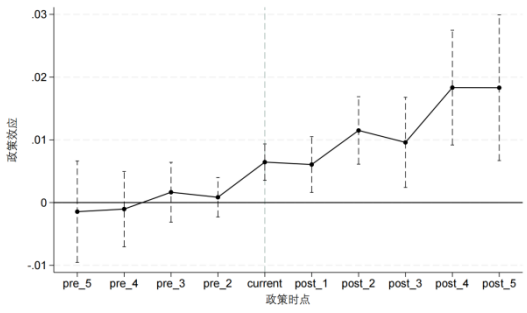
$$KnowDiv_{it}=\eta_0+\eta_m Policy_{it}^{n}+\eta_i X_{it}+\mu_t+v_i+\varepsilon_{it}$$

where i is the firm identifier, t is the year identifier, and n represents the relative position of the year with respect to the pilot program: 0 denotes the year the pilot was implemented, negative values indicate the period before the pilot, and positive values indicate the period after the pilot. The definitions of the remaining variables follow those of the baseline model.As shown in Figure 1, the coefficients for all periods prior to the implementation of the pilot program failed the significance test, indicating that there were no systematic differences in innovation quality trends between the experimental and control groups; after the implementation of the pilot program, the coefficients became significantly positive, confirming that the parallel trends hypothesis is satisfied.

2. Placebo Test

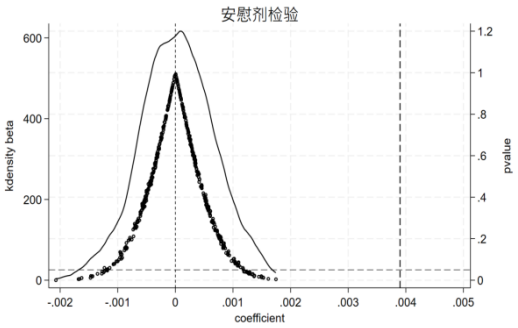
To rule out the interference of non-policy factors, a random sampling method was used to randomly select a virtual treatment group from the sample for regression analysis, repeated 500 times. The results show that the estimated coefficients for the virtual treatment group are concentrated around 0 and follow a normal distribution, exhibiting a clear difference from the actual policy effects, indicating that the conclusions are not driven by other random factors. The results are shown in Figure 2.

Figure 1. Parallel Trends Test



Source: authors

Figure 2. Placebo Test



Source: authors

(3) Robustness Tests

1. Replacing the Dependent Variable

Granted patents have undergone substantive examination by the National Intellectual Property Administration and meet higher standards for technical novelty, inventiveness, and utility; they are therefore a better representation of a company's core achievements that possess genuine innovative value.As shown in Model (1) in Table 3, the incentivizing effect of standardization policies on the quality of corporate innovation is once again validated.

2. Combined Fixed Effects and Changing Cluster Levels

This paper further controls for the joint firm-city fixed effects to minimize the impact of unobservable factors that vary over time and differ across cities.The regression results are shown in Model (2) of Table 3. After adding the joint fixed effect, the estimated coefficient of Policy is still significantly positive at the 5% level, indicating that the treatment effect identified in this paper is not driven by time-varying structural differences at different city levels.Additionally, by adjusting the cluster standard error to the industry level to address autocorrelation within industry groups, the regression results shown in Table 3, Model (3) confirm that the core conclusions remain robust, and the statistical inferences are not affected by the choice of clustering level.

3. Excluding Municipalities Directly Under the Central Government

The four municipalities directly under the central government—Beijing, Shanghai, Tianjin, and Chongqing—differ significantly from other prefecture-level cities in terms of policy implementation, resource allocation, and economic development levels. After re-estimating the model by excluding enterprise samples from these municipalities, the results shown in Model (4) of Table 3 confirm that the conclusions remain valid.

4. Adding Control Variables

Factors such as regional economic development and city size may simultaneously influence policy implementation and firm innovation behavior; failing to control for these could lead to omitted variable bias. By further incorporating city-level economic development (GDP) and population size (POP) as control variables, the results shown in Model (5) of Table 3 indicate that the estimated coefficient of the policy variable is significantly positive at the 1% level, suggesting that the selection of the policy variable is valid.

5. System GMM Estimation

This paper re-estimates the model using the System Generalized Method of Moments (System GMM) approach.By introducing lagged terms of the dependent variable as instrumental variables, this method effectively controls for endogeneity in dynamic panel models while overcoming the potential issue of weak instrumental variables in difference GMM. Column (1) of Table 4 reports the System GMM estimation results, where the coefficient of the one-period lag of the dependent variable is significantly positive at the 1% level, indicating that the quality of firm innovation does indeed exhibit significant path-dependence characteristics.

6. One-period lag of the dependent variable

The implementation of policy effects requires a transmission period; focusing solely on the current-period effects of policies may underestimate the true promotional role of standardization efforts on corporate innovation quality. Incorporating the one-period lag of the core explanatory variables into the model yields the results shown in Column (2) of Table 4: the coefficient of the Policy lag term is 0.0496, which is significantly positive at the 1% level, indicating that the promotional effect of standardization efforts on corporate innovation quality possesses a sustained dynamic impact.

7. Controlling for Other Policy Interferences

The High-Tech Enterprise Certification policy implemented during the same period may influence corporate innovation quality. After including a dummy variable for High-Tech Enterprise Certification, the results shown in Column (3) of Table 4 indicate that the coefficient for Policy remains highly significant, suggesting that the effects of standardization efforts are independent of this policy.

8. Propensity Score Matching (PSM)

To mitigate selection bias caused by pre-existing differences in characteristics between the treatment and control groups, the PSM method was used for 1:1 nearest-neighbor matching. Based on re-estimation using the matched sample, the results shown in Column (4) of Table 4 indicate that the Policy coefficient is 0.0060, which is significant at the 1% level, confirming the robustness of the conclusion.

Table 3. The Impact of Standardization on Firm Innovation Quality: Robustness Test Results I

Dependent Variable KnowDiv	(1)	(2)	(3)	(4)	(5)
Policy	0.0988***	0.0037**	0.0039***	0.0033**	0.0044***
	(34.4082)	(2.4885)	(2.7430)	(1.9704)	(2.9527)
GDP					0.0046
					(1.2071)
POP					-0.0010
					(-0.1450)
Control variable	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm-specific effects	Yes	Yes	Yes	Yes	Yes
Fixed Effects of Firm-City Interactions	No	Yes	No	No	No
Observation count	20067	39,002	39,002	31,589	35,110
Adjusted R^2	0.5373	0.1522	0.5344	0.5157	0.5370

Note: Figures in parentheses represent robust standard errors clustered at the firm level; ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively. *Source: authors*

Table 4. The Impact of Standardization on Firm Innovation Quality: Robustness Test Results II

Dependent Variable *KnowDiv*	(1)	(2)	(3)	(4)
KnowDiv First-order lag term	0.6723***			
	(29.9503)			
Policy First-order lag term		0.0496***		
		(26.2710)		
Dummy variable for high-tech enterprise certification policy			0.0141**	
			(2.0505)	
Policy	0.0026***		0.0989***	0.0060***
	(7.8947)		(34.4607)	(3.0948)
Control variable	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm-specific effects	Yes	Yes	Yes	Yes
Number of observations	33,040	33,040	39,002	31,589
Adjusted R^2		0.5799	0.5244	0.5157

*Note: Figures in parentheses represent robust standard errors at the firm level; ***, (**),and *denote significance levels of 1%, 5%, and 10%, respectively*

Source: authors

(4) Mechanism Analysis

Based on the aforementioned theoretical analysis and baseline regression results, standardization efforts may influence firm innovation quality through two channels: resource allocation efficiency and managerial focus on innovation. To this end, this study conducts the following tests:

1. Resource Allocation Efficiency: To test this mechanism, this study adopts the methods of Ni and Wang (2022)and Richardson (2006), using the investment efficiency deviation (INVEFF) and the degree of labor mismatch (LABMIS) to measure firms' resource allocation efficiency.First, we estimate the optimal investment level for firms. We then measure investment efficiency using the absolute deviation between actual and optimal investment (INVEFF); a higher value indicates more severe resource misallocation and lower resource allocation efficiency. Column (1) of Table 5 presents a regression with INVEFF as the dependent variable.

The coefficient for Policy is significantly negative at the 1% level, indicating that standardization significantly reduces the degree of resource misallocation, thereby improving investment efficiency.Next, we construct a model to estimate the firm's optimal employee size and measure the degree of labor misallocation using the absolute deviation between actual and optimal employee numbers. A higher value of this indicator indicates lower labor allocation efficiency. Column (2) of Table 5 performs a regression with labor allocation efficiency as the dependent variable, and the estimated coefficient for Policy is significantly negative at the 1% level. This indicates that standardization significantly reduces the misallocation of capital and labor resources, thereby improving resource allocation efficiency.

2. Managers' Focus on Innovation: Drawing on the research methodology of Li et al. (2025) , this study employs text analysis to measure executives' focus on innovation.Specifically, the "Management's Discussion and Analysis" (MD&A) section of annual reports for the observed years was used as the analysis text.

Innovation-related keywords (such as technological innovation, R&D, patents, and inventions) were screened, their frequency of occurrence was counted, and the ratio of this word frequency to the total number of words in the MD&A section was used as a measure of executive attention to innovation.

As shown in column 3 of Table 5, the coefficient for Policy is significantly positive (0.0375), indicating that standardization significantly enhances managers' attention to innovation activities.

These results support Hypotheses H1 and H2.The results in Column 4 of Table 5 demonstrate that

both corporate resource allocation efficiency and managers' attention to innovation significantly influence corporate innovation quality.

Table 5. The Impact of Standardization on Corporate Innovation Quality: Testing the Mechanism of Influence

	(1) INVEFF	(2) LABMIS	(3)Attention	
Policy	-0.0095***	-0.0010***	0.0375***	
	(-8.3801)	(-15.1092)	(2.4595)	
INVEFF				-0.0164*
				(-1.6784)
LABMIS				-0.5094*
				(-1.6974)
Attention				0.0020*
				(1.7574)
Control variables	Yes	Yes	Yes	
Firm fixed effects	Yes	Yes	Yes	
Year fixed effects	Yes	Yes	Yes	
Number of observations	35,788	32,969	38,378	
Adjusted R^2	0.2059	0.7378	0.5782	

*Note: Values in parentheses are robust standard errors clustered at the firm level; ***, **, and *denote significance levels of 1%, 5%, and 10%, respectively.*

Source: authors

(5) Heterogeneity Analysis

This section further conducts a heterogeneity analysis across three dimensions—ownership structure, regional marketization level, and industry factor intensity—to identify the boundary conditions under which standardization efforts influence the quality of enterprise innovation.

1.Property rights nature: Columns (1) and (2) of Table 6 present the grouped regression results based on property rights types.Standardized construction has a significant promoting effect on the innovation quality of non-state-owned enterprises (coefficient 0.0163), and has no significant impact on state-owned enterprises. The likely reason is that non-state-owned enterprises have a higher degree of marketization and more flexible decision-making mechanisms, enabling them to more rapidly capitalize on the institutional benefits of standardization reforms and reallocate resources to innovation activities; whereas state-owned enterprises, despite their close ties to the government, face multiple administrative levels, lengthy decision-making chains, and certain agency problems, which to some extent undermine the effectiveness of policy implementation.

2.Marketization degree: Columns (3) and (4) of Table 6 present the grouped regression results based on regional marketization levels.In regions with a relatively high level of marketization, the policy effect is significantly positive (coefficient 0.0050); in regions with a relatively low level of marketization, it is not significant. This indicates that standardization efforts have a stronger promoting effect on the innovation quality of enterprises in regions with higher marketization levels. It also reflects that such regions possess more robust institutional environments and freer factor flows, enabling standardization reforms to create synergies with existing market mechanisms and more effectively enhance corporate innovation quality.

3. Industry Factor Intensity: Columns (5) to (7) of Table 6 present the grouped regression results based on industry factor intensity.In technology-intensive industries, the policy effect is significantly positive (coefficient 0.0042); in asset-intensive and labor-intensive industries, it is not significant. This indicates that standardization efforts have a more significant positive impact on the innovation quality of enterprises in technology-intensive industries. This disparity reflects the frequent updates and greater complexity of technical standards in these industries, meaning standardization plays a stronger guiding role in shaping their technological roadmaps and enhancing R&D efficiency

Table 6. The Impact of Standardization on Enterprise Innovation Quality: Heterogeneity Test

Variables	(1) State-owned enterprises	(2) Non-state-owned enterprises	(3) High Level of Marketization	(4) Low level of marketization	(5) Technology-intensive	(6) Capital-intensive	(7) Labor-intensive
Policy	0.0030	0.0163***	0.0050***	-0.0013	0.0042***	0.0038	0.0032
	(1.0314)	(7.1606)	(3.2280)	(-0.1808)	(2.6102)	(1.0502)	(1.0249)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-specific effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation count	12,554	26,448	33,450	5,552	20,256	7,022	11,420
Adjusted R^2	0.4957	0.1651	0.5540	0.4614	0.6466	0.4940	0.5141

*Note: The values in parentheses are t-values; ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.*

Source: authors

CONCLUSIONS AND POLICY RECOMMENDATIONS

(1) Main Conclusions

Using the national comprehensive standardization reform pilot program as a quasi-natural experiment, this study employs a multi-period difference-in-differences model based on data from Chinese A-share listed companies from 2010 to 2024 and reaches the following conclusions:

1.Standardization efforts can significantly improve the quality of corporate innovation, with their incentive effects on innovation being particularly pronounced in non-state-owned enterprises, regions with higher levels of marketization, and technology-intensive industries.

2. Improving resource allocation efficiency through both capital and labor dimensions, as well as increasing managers' focus on innovation, are two key transmission channels through which standardization drives improvements in corporate innovation quality.

3.The complete transmission chain driven by standardization efforts—spanning from the institutional environment to micro-level firm behavior—provides empirical evidence for understanding how government-led standardization reforms empower high-quality corporate development.

This study has the following limitations: the measurement of innovation quality is based solely on patent knowledge breadth, which may fail to

fully capture non-patent innovation activities such as process improvement and business model innovation; secondly, the sample is limited to A-share listed companies, so the conclusions should be applied with caution to unlisted small and medium-sized enterprises. Future research could therefore focus on the following areas: refining the innovation quality measurement framework by incorporating multiple indicators; expanding the analysis to include unlisted companies to enhance the external validity of the findings.

(2) Policy Recommendations

First, accelerate the in - depth integration of standardization and industrial innovation. It is recommended to focus on supporting the development of key technical standards in areas with concentrated technology - intensive industries to seize the discourse power in standards; in areas where traditional industries account for a relatively high proportion, promote the transformation and upgrading empowered by standards.

Second, improve the incentive and service system for enterprise standardization construction. In response to problems such as the shortage of standardization talents and poor information channels in non - state - owned enterprises and small and medium - sized enterprises, build a standardization service platform for government - enterprise docking to provide comprehensive services such as standard consultation, technical guidance, and financial subsidies.

Third, smooth the transmission path for standardization reform to promote enterprise innovation. On the one hand, deepen the reform of the market - based allocation of factors and reduce the government's administrative intervention in the prices of capital and labor; on other the hand, guide enterprises to combine standardization construction with lean management, and focus limited resources on core technology breakthroughs through standardized processes. At the same time, give full play to the signal - transmission function of standards to reduce the uncertainty of managers' innovation decisions.

REFERENCES

[1] An, Y. M., & Chen, Q. (2025). Can standardized governance stimulate urban entrepreneurial vitality? A quasi-natural experiment based on national comprehensive standardization reform pilots. *Studies in Science of Science,* 1–20.

[2] Blind, K., Neuhäusler, P., & Schubert, T. (2026). The economic effects of the quality infrastructure. *Technology in Society*, 84, 102830.

[3] Hao, Z. X., & Ye, Y. (2024). How to break the deadlock in corporate patent transactions? A quasi-natural experiment from the national comprehensive standardization reform pilot program. *Studies in Science of Science*, 43(10), 2166–2175.

[4] Li, H. H., Xie, E., Liu, X. T., et al. (2025). The impact of digital transformation on sustained innovation investment in manufacturing enterprises: A moderated mediation model of managers' attention to innovation. *Research and Development Management*, 37(4), 150–162.

[5] Ni, T. T., & Wang, Y. T. (2022). Regional administrative integration, factor marketization, and the efficiency of enterprise resource allocation. *Journal of Quantitative & Technical Economics*, 39(11), 136–156.

[6] Richardson, S. (2006). Over-investment of free cash flow. *Review of Accounting Studies*, 11(2), 159–189.

[7] Wang, X. C., Hu, X. H., & Ling, C. (2023). Executive team innovation attention, technology M&A, and corporate innovation performance: Empirical evidence from Chinese listed companies. *Science and Technology Management*, 44(11), 166–182.

[8] Yuan, S. J., Yu, L. P., Zhong, C. B., et al. (2020). Do innovation policies promote quantity or quality of innovation? A case study of high-tech industries. *China Soft Science*, (3), 32–45.

[9] Zhang, J., & Zheng, W. P. (2018). Has the innovation catch-up strategy hindered the quality of Chinese patents? *Economic Research Journal*, 53(5), 28–41.