

The Impact of the Industrial Internet on the New Quality Productivity of Distribution Enterprises

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Abstract: *This study empirically investigates the impact of industrial internet on the new quality productivity of Chinese distribution enterprises using PSM-DID methods and panel data from 2013 to 2023. Results reveal a positive and robust effect of industrial internet on new quality productivity, with significant heterogeneity across property rights and regions—non-state-owned enterprises and western-region firms exhibit stronger responses. Mechanism analysis shows that industrial internet enhances technological innovation and data assets, thereby promoting new quality productivity. Policy implications include prioritizing new infrastructure development, implementing tiered industrial internet initiatives, and accelerating digital transformation in distribution enterprises.*

Keywords: Industrial Internet, New Quality Productivity, PSM-DID, Distribution Enterprises.

1. Introduction and Literature Review

The new quality productive force is an expansion and deepening of traditional productive forces, characterized by high efficiency and high quality, and driven by innovation, liberation, and development, promoting high-quality economic development (Zhong Bin and Zhang Han, 2024). As a product of the deep integration of new-generation information technology and manufacturing, the industrial internet is having a comprehensive, profound, and revolutionary impact on the cultivation and development of new quality productive forces for distribution enterprises. On one hand, the industrial internet fully penetrates the industrial and supply chains, effectively enhancing the supply chain collaboration efficiency of distribution enterprises through the comprehensive interconnection of people, machines, and things, which is conducive to innovation-driven high-quality development of distribution enterprises; on the other hand, the industrial internet platform can effectively integrate innovative resource elements, identify and analyze key core technologies, and improve data circulation levels, providing critical foundational support for breakthroughs in core technologies of distribution enterprises. Therefore, as the application scenarios of the industrial internet become increasingly widespread, it is of great theoretical and practical significance to deeply understand the important role and mechanism of the industrial internet in the development of new quality productive forces for distribution enterprises and to propose targeted suggestions.

Existing literature has conducted beneficial explorations around the cultivation and development of new quality productive forces. At the macro research level of new quality productive forces: existing industrial policies need to be reformed, focusing on shifting from capacity expansion to innovation support, and improving the driving mechanism of new quality productive forces (Liu Zhibiao, 2024); the strong permeability, multi-compatibility, and super spatiotemporal nature of new quality productive forces should be grasped, building a good relationship between an efficient and active government and an efficient and fair market, opening up new tracks, and establishing new mechanisms (Cheng Enfu and Liu Meiping, 2024). At the micro research level of new

quality productive forces: actively guiding and encouraging enterprises to undergo digital and intelligent transformation, enhancing the absorption energy path to develop new quality productive forces in private enterprises and mature enterprises (Xie Jiaping et al., 2025); accelerating the application of emerging technology scenarios, cultivating new quality productive forces through the "engineering-commercialization-industrialization" pathway (Fang Xiaoxia and Li Xiaohua, 2024).

Although few scholars have discussed the cultivation and development of new quality productive forces from the perspective of the industrial internet, the essence of the formation of new quality productive forces is the entry of new technologies and new factors into the production function and their continuous optimization of allocation. Therefore, research on the impact of the industrial internet on total factor productivity and technological innovation provides useful references for this article. For example, Li Xiaokang's (2024) study shows that the industrial internet promotes corporate collaborative innovation by improving internal management efficiency and external communication efficiency; Wang Chang et al. (2024) pointed out that the industrial internet promotes corporate intelligent transformation through paths such as cultivating digital capabilities and resource readiness capabilities.

In view of this, based on the data of China's listed distribution enterprises from 2013 to 2023, this paper empirically examines the impact of the industrial internet on the new quality productivity of distribution enterprises using the PSM-DID method and investigates the heterogeneity of property rights and regional differences. The contributions of this paper are as follows: First, the quantitative analysis of the impact of the industrial internet on the new quality productivity of distribution enterprises makes up for the shortcomings of existing research and provides a new direction for the development of new quality productivity of distribution enterprises; Second, the systematic study of factors such as property rights and regions deeply analyzes the relationship between the industrial internet and the new quality productivity of distribution enterprises, providing a theoretical basis for relevant policy formulation.

2. Theoretical Basis and Research Hypotheses

2.1 Characteristics and Connotations of New Quality Productivity in Distribution Enterprises

The new quality productivity of distribution enterprises is a new productivity that guides high-quality development, with distinct "new quality" characteristics, where the "new" trait is innovation-driven, and the "quality" traits are high technology, high efficiency, and high quality. Further, the advanced connotation of the new quality productivity of distribution enterprises is as follows: First, innovation-driven is the main path. The new quality productivity of distribution enterprises emphasizes the creation of new momentum and new models, with technological innovation being the core element in transforming and upgrading traditional industry models and efficiency, and a key path to accelerating the optimization and upgrading of the industrial structure. Second, the improvement of total factor productivity is the main indicator. The formation of new quality productivity in distribution enterprises essentially involves new technologies and new factors entering the production function and continuously optimizing allocation; guiding and promoting the flow of advanced quality production factors to new quality productivity within the construction of new production relations is crucial, ultimately promoting productivity development through the spiral rise of total factor productivity and technological innovation. Third, the improvement of productivity quality is the main requirement. The high-quality economic development under the new development pattern imposes quality requirements on productivity. The cultivation and development of new quality productivity in distribution enterprises stem not only from technological innovation but also from the continuous optimization of production relations, thus inevitably manifesting as an enhancement in the quality level of productivity in outcomes.

2.2 Impact of Industrial Internet on New Quality Productivity in Distribution Enterprises

The industrial Internet is a new industrial ecosystem based on the deep integration of digital technology and industrial technology. Overall, the industrial Internet mainly affects the new quality productivity of distribution enterprises through mechanisms such as technological innovation, industrial integration, and factor empowerment: First, the technological innovation mechanism. On the one hand, the industrial Internet platform characterized by "cloud + network + terminal" and data thinking can effectively integrate diversified innovation resource elements, improve the interconnection efficiency of modern industries, and allocate innovation factors more reasonably and efficiently with the support of technologies such as artificial intelligence and big data, thereby promoting breakthroughs in key core technologies of distribution enterprises; on the other hand, as cloud computing, blockchain and other technologies are applied in industrial Internet fusion scenarios, new business forms such as personalized customization also emerge, forcing distribution enterprises to innovate service scenarios and optimize technological innovation directions, driving high-quality productivity development. Second, the industrial integration mechanism. The industrial Internet provides an effective support platform for industrial integration,

promoting the deep integration of the real economy and information technology through new infrastructure, giving rise to a new industrial ecosystem; at the same time, the industrial Internet weakens industry and sector boundaries in the process of advancing full-factor interconnection, promoting data circulation between production and consumption, manufacturing and supply, products and services, thus forming and developing new industrial integration models and business forms (Yang Haichao, 2022). Third, the data factor empowerment mechanism. Traditional industries can achieve the collection, storage, and analysis of data factors based on the industrial Internet platform, realizing the integration of industrial production factors in the safe and stable data supply services of the industrial Internet, guiding data factors to empower traditional factors such as capital, labor, and technology, thereby improving productivity quality. In summary, the following research hypotheses are proposed:

H1: The industrial Internet has a positive impact on the development of new quality productivity of distribution enterprises, that is, there exists a new quality productivity promotion effect.

2.3 Property Rights and Regional Heterogeneity Analysis

The impact of the industrial internet on the new quality productive forces of distribution enterprises exhibits heterogeneity in ownership and region. From the perspective of ownership, state-owned and non-state-owned distribution enterprises differ in their innovative resource endowments. State-owned distribution enterprises enjoy superior policy support (e.g., financing) compared to non-state-owned ones in fostering and developing new quality productive forces, showing less elasticity in response to dynamic changes in the market environment. Non-state-owned distribution enterprises have weaker capabilities in acquiring information through emerging technologies (Ren Li, 2020) and thus have a stronger motivation to adopt the industrial internet in cultivating and developing new quality productive forces. From the regional disparity perspective, the eastern region has richer internet and information resources and higher economic development levels than the central and western regions. Due to the regional differences inherent in new information technologies, the industrial internet's impact on the new quality productive forces of distribution enterprises in different regions will inevitably vary due to factors such as market foundation, policy orientation, and resource endowments. Based on the above, the following research hypotheses are proposed:

H2a: The positive impact of the industrial internet on the development of new quality productive forces in distribution enterprises exhibits ownership heterogeneity.

H2b: The positive impact of the industrial internet on the development of new quality productive forces in distribution enterprises exhibits regional heterogeneity.

3. Research Design

3.1 Variable Description

Core explanatory variable: Industrial Internet (DID). The

industrial internet is a policy-related variable, and this paper sets this indicator as a dummy variable, i.e., DID=treat × time. Here, treat is a group dummy variable; if an enterprise adopts relevant technologies of the industrial internet, then treat=1, otherwise 0. Considering that the concept of the industrial internet was introduced in 2012, and drawing on the research by Wang Yurong et al. (2022), this paper uses keyword mining analysis from corporate annual reports to determine whether industrial internet technology has been adopted, with keywords including "industrial internet," "internet of things," "data thinking," "business middleware," "intelligent connectivity," and "Industry 4.0." Time is a time dummy variable; if the enterprise is within the implementation period of the industrial internet policy, then time=1, otherwise 0. Given that the industrial internet was officially included in government work reports in 2018 and explicitly mentioned in the subsequent seven years of government work reports, we set time=0 before 2018 and 1 for other years.

Core explained variable: New Quality Productivity (NQP) of

distribution enterprises. Currently, there is limited quantitative research on enterprises' new quality productivity in academia, with some literature using the entropy method for measurement. Drawing on the approach by Song Jia et al. (2024), we construct an evaluation index system for new quality productivity of distribution enterprises from two dimensions: means of production and tools of production (see Table 1), and use the entropy method to calculate the weight of each index, thereby computing the level of new quality productivity of distribution enterprises.

Control variables: To avoid omitted variable bias, the empirical analysis further controls for the following variables that may affect the development of new quality productivity in distribution enterprises: firm size (size), debt-to-asset ratio (debt), capital intensity (cap), return on assets (roa), cash flow (cash), growth (growth), and ownership concentration (ratio). Variable definitions and descriptive statistics are shown in Table 1.

Table 1: Evaluation Index System for New Quality Productivity of Distribution Enterprises

Primary Indicator	Secondary Indicator	Tertiary Indicators and Calculation Instructions	Weight
Means of Production	Labor Force	Proportion of R&D Personnel: Number of R&D Personnel / Total Employees	9
		Proportion of Highly Educated Personnel: Number with Bachelor's Degree or Above / Total Employees	5
		Proportion of R&D Personnel Salaries: (R&D Expenses - Salary and Wages) / Operating Revenue	13
	Object of Labor	Fixed Assets Ratio: Fixed Assets / Total Assets	6
		Intangible Assets Ratio: Intangible Assets / Total Assets	3
Means of Production Tools	Hardware Tools	Proportion of R&D Depreciation and Amortization: (R&D Expenses - Depreciation and Amortization) / Operating Revenue	11
		Proportion of R&D Leasing Fees: (R&D Expenses - Leasing Fees) / Operating Revenue	13
		Proportion of Direct R&D Investment: (R&D Expenses - Direct Investment) / Operating Revenue	22
	Software Tools	Total Asset Turnover: Operating Revenue / Average Total Assets	9
		Reciprocal of Equity Multiplier: Owners' Equity / Total Assets	9

3.2 Sample Selection and Data Sources

The sample of this paper selects data from listed circulation enterprises in China, based on the concept of "Industrial Internet" proposed in 2012, with an empirical sample time span chosen from 2013 to 2023. The specific processing of the sample is as follows: excluding ST, *ST, and PT type samples; excluding samples that are insolvent or have been listed for less than one year; excluding samples with severe missing key data; performing Winsorize treatment on continuous variables at the 1% and 99% quantiles. All data required for the empirical analysis come from the CSMAR database and the Juchao Information Network.

3.3 Model Design

To test the promoting effect of Industrial Internet policy implementation on the new quality productivity of circulation enterprises, the following Difference-in-Differences (DID) model is constructed:

$$NQP_{it} = \alpha_0 + \alpha_1 DID + \sum \alpha_i Control_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Where DID is the dummy variable for the Industrial Internet; NQP represents the new quality productivity of circulation enterprises; Control is a set of control variables; μ and λ are individual fixed effects and time fixed effects respectively; ε is the random disturbance term.

4. Empirical Analysis

4.1 Baseline Regression Analysis

Column (1) of Table 3 presents the Probit model estimation propensity score results including only core variables (DID method), with the impact coefficient of the Industrial Internet on the new quality productivity of circulation enterprises being 0.193, passing the 1% statistical test; Column (2) presents regression results after adding a series of control variables, with the impact coefficient of the Industrial Internet on the new quality productivity of circulation enterprises being 0.245, also passing the 1% statistical test, and the goodness-of-fit of column (2) being higher than that of column (1). The results indicate that the Industrial Internet has a positive impact on the development of new quality productivity of circulation enterprises, verifying the establishment of research hypothesis H1.

4.2 PSM-DID Test

This paper will adopt samples of Industrial Internet enterprises above the median as the treatment group, and the rest as the control group. Selecting enterprise size, age, return on net assets, etc., as covariates, and the new quality productivity of circulation as the outcome variable, matching is performed at a 1:1 ratio with replacement. The results show that there is no significant difference in the mean values of the covariates between the treatment group and the control group at the 1% statistical level, i.e., it passed the balance test (due to

space limitations, the balance test results are not listed). Table 4 presents the PSM-DID test results of the Industrial Internet’s impact on the new quality productivity of circulation enterprises. The DID coefficient before adding control variables is 0.281, passing the 1% statistical test; the DID coefficient after adding control variables is 0.266, also passing the 1% statistical test. The results indicate that the implementation of Industrial Internet policies has a positive impact on the development of new quality productivity of circulation enterprises, again verifying the establishment of hypothesis H1 .

4.3 Robustness Test

First, the time placebo test. To ensure that the positive impact of industrial internet on the new quality productivity of distribution enterprises is not caused by accidental events, this paper sets a "pseudo" pilot time for the sample companies to regress, advancing the adoption time of industrial internet policy by 3 years. The results in Table 5 show that the DID coefficient is 0.004, failing the significance test, indicating no systematic difference in the time trend between the treatment and control groups, suggesting that the sample companies increased their new quality productivity after adopting the industrial internet policy, verifying the robustness of the benchmark regression conclusion.

Second, change the PSM matching method. This paper further adopts caliper matching, radius matching, and Mahalanobis matching methods to examine the impact of industrial internet on the new quality productivity of distribution enterprises. The results in Table 5 show that the average treatment effect on the treated (ATT) values of distribution enterprises adopting the industrial internet policy are 0.602, 0.771, and 0.649, respectively, all passing the statistical test of 1% , again verifying the robustness of the conclusions.

4.4 Heterogeneity Analysis

To investigate the heterogeneity of the impact of industrial internet on the new quality productivity of distribution enterprises, the sample companies are divided into state-owned property rights and non-state-owned property rights based on property rights differences, and into eastern, central, and western enterprises based on regional differences. The suest estimation and inter-group coefficient test results indicate that the disturbance terms between groups are unrelated. According to the results in Table 6, the coefficients of industrial internet in the state-owned and non-state-owned property rights groups are 0.155 and 0.231, respectively, both passing the 1% statistical test; the coefficients in the eastern, central, and western enterprise groups are 0.189, 0.183, and 0.215, respectively, all passing the 1% statistical test. The results indicate that the positive impact of industrial internet on the new quality productivity of non-state-owned enterprises is significantly higher than that of state-owned enterprises, and the positive impact on the new quality productivity of western enterprises is significantly higher than that of eastern and central enterprises. Possible reasons are as follows: First, non-state-owned enterprises have weaker resource acquisition capabilities in developing new quality productivity, so the marginal output effect after adopting industrial internet is more pronounced; second, the

information technology level in the western region is lower than that in the eastern and central regions, so the marginal benefit of the impact of industrial internet policies is more prominent.

Table 2: Variable Definitions and Descriptive Statistics

Variable	Symb ol	Measurement Method	Mean	Standard Deviation	Medi an
Industrial Internet	DID	Dummy Variable	0.211	0.428	0.184
New Quality Productivity	NQP	Entropy Method Calculation	4.206	1.335	4.052
Firm Size	size	Natural Logarithm of Total Assets	19.169	0.944	7.018
Debt-to-Asset Ratio	debt	Ratio of Total Liabilities to Total Assets	0.256	0.419	0.350
Capital Intensity	cap	Ratio of Total Assets to Operating Revenue	3.301	29.645	10.703
Return on Assets	roa	Ratio of Net Profit to Total Assets	0.049	0.962	0.025
Cash Flow	cash	Ratio of Net Cash Flow to Total Assets	0.051	0.686	0.067
Growth	growt h	Ratio of Sales Revenue Increase to Previous Year’s Revenue	0.249	1.153	0.118
Equity Concentration	ratio	Ratio of the Largest Shareholder’s Stake to Total Company Shares	0.326	0.528	0.295

Table 3: Results of the benchmark regression analysis

Variable	(1)	(2)
DID	0.193** (4.21)	0.245** (5.18)
size		0.079 (2.40)
debt		-0.009 (-0.76)
cap		0.013*(1.71)
roa		0.032** (2.29)
cash		0.011 (1.02)
growth		-0.028 (-1.45)
ratio		-0.007 (-1.18)
Constant	3.083** (11.54)	5.922** (13.76)
Individual effect	YES	YES
Time effect	YES	YES
Adj R ²	0.247	0.301

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels respectively; values in parentheses are t-values, same below.

Table 4: PSM-DID Test Results

Variable	(1)	(2)
DID	0.281	0.266** (8.32)
Constant	4.133** (19.25)	5.708** (21.08)
Control variables	NO	YES
Individual effects	YES	YES
Time effects	YES	YES
Adj R ²	0.081	0.097

Table 5: Robustness Test Results

Variable	Time Placebo Test	Change PSM Matching Method		
		Caliper Matching	Radius Matching	Mahalanobis Matching
DID	0.004 (0.000)			
ATT		0.602 (0.033)	0.771 (0.040)	0.649 (0.052)
Individual/Time	YES	YES	YES	YES
Control Variable	YES	YES	YES	YES
Adj R	0.371	0.402	0.399	0.394

Note: All three types of matching results are obtained through the Bootstrap method.

4.5 Analysis of Impact Mechanism

This paper constructs the following model using technological innovation and data assets of distribution enterprises as mediating variables to empirically test the impact mechanism of industrial internet on the new quality productivity of distribution enterprises:

$$TEC_{it} = \beta_0 + \beta_1 DID_{it} + \sum \beta_j Control_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

$$NQP_{it} = \gamma_0 + \gamma_1 TEC_{it} + \gamma_2 DID_{it} + \sum \gamma_j Control_{it} + \mu_i + \lambda_t + \varepsilon \quad (3)$$

$$DATA_{it} = \phi_0 + \phi_1 DID_{it} + \sum \phi_j Control_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (4)$$

$$NQP_{it} = \theta_0 + \theta_1 DATA_{it} + \theta_2 DID_{it} + \sum \theta_j Control_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (5)$$

Among them, TEC represents the level of technological innovation, which is measured by the number of enterprise patent authorizations; DATA represents data assets. Referring to the approach of Yuan Zeming et al. (2024), it is calculated using the method of "seed word screening + AutoPhrase similar word expansion + SnowNLP sentiment polarity analysis".

According to the results in Table 7, the impact coefficient of industrial internet on technological innovation in distribution enterprises is 0.302, passing the 1% statistical test; the impact coefficient of technological innovation on new quality productivity in distribution is 0.516, also passing the 1% statistical test, and the impact coefficient of industrial internet on new quality productivity in distribution is significantly positive at the 1% statistical level. The impact coefficient of industrial internet on data assets in distribution enterprises is 0.179, passing the 1% statistical test; the impact coefficient of data assets on new quality productivity is 0.371, also passing the 1% statistical test, and the impact coefficient of industrial internet on new quality productivity is significantly positive at the 1% statistical level. The results indicate that industrial internet has a positive impact on both technological innovation and data assets in distribution enterprises, and can promote the development of new quality productivity in distribution enterprises by enhancing technological innovation and expanding data assets.

Table 6: Heterogeneity Test Results

Variable	Ownership		Region		
	State Ownership	Non-state Ownership	Eastern Firms	Central Firms	Western Firms
DID	0.155 (4.01)	0.231 (3.86)	0.189 (3.25)	0.183 (3.85)	0.215 (3.79)
Constant	3. (6.82)	4.001*** (7.42)	2.194 (5.20)	3.185** * (6.22)	4.042*** (6.59)
Control Variables	YES	YES	YES	YES	YES
Individual/Time	YES	YES	YES	YES	YES
Adj R	0.291	0.302	0.288	0.273	0.275

Table 7: Test Results of Impact Mechanism

Variable	Technological Innovation		Data Asset	
	TEC	NQP	DATA	NQP
DID	0.302	0.516 (3.04)	0.179 ~ (3.50)	0.226** (3.73)
DATA				0.371 30.683
Individual/Time	YES	YES	YES	YES
Control Variable	YES	YES	YES	YES
Adj R ²	0.139	0.382	0.108	0.377

Variable	TEC	NQP	DATA	NQP
DID	0.302	0.516 (3.04)	0.179 ~ (3.50)	0.226** (3.73)
DATA				0.371 30.683
Individual/Time	YES	YES	YES	YES
Control Variable	YES	YES	YES	YES
Adj R ²	0.139	0.382	0.108	0.377

5. Suggestions

First, strengthen the construction of new infrastructure. Investment in new Internet technologies and information technology infrastructure should be increased to cultivate and build leading industrial Internet platform enterprises, fully unleashing the driving effect of the industrial Internet on the new quality productive forces in circulation. Second, implement hierarchical industrial Internet measures. Targeted industrial Internet measures should be implemented according to the development stage of new quality productive forces in circulation enterprises: focus on acquiring innovative technological resources in the primary stage, enhance the topology and integration of innovative resources in the intermediate stage, and promote the multiplication of main value creation and the recombination of the value chain in the advanced stage. Third, accelerate the digital and intelligent transformation of circulation enterprises. Enterprises should act as micro carriers to achieve digital and intelligent transformation through market demand guidance, and further choose suitable paths to connect to industrial Internet platforms, realizing collaborative innovation and value co-creation for circulation enterprises under industrial Internet coverage.

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