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Does the National Digital Economy Innovation and Development Pilot Zone Promote Corporate Digital Transformation?

—An Empirical Evidence Using New Measurement

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Abstract

Based on data from Chinese A-share listed companies from 2015 to 2023, this paper constructs the comprehensive index for corporate digital transformation using text analysis and PCA/FA methods. It empirically examines the driving effect and mechanisms of the "National Digital Economy Innovation and Development Pilot Zone" policy on corporate digital transformation using a multi-period difference-in-differences (DID) model. The findings are as follows: First, the pilot zone policy significantly promotes the digital transformation of enterprises in the pilot areas, a conclusion that remains robust after variable substitution and corporate characters. Second, the policy effect exhibits a dynamic evolution characteristic of "practice before output", with an immediate impact on the practical aspects of corporate digitalization, while the transmission to digital output and capital market recognition shows a certain time lag. Third, the policy intensity generates positive spillover effects, not only strengthening the overall promotion of corporate digitalization levels but also gradually guiding capital market attention towards the value of corporate digitalization. This study not only provides new empirical evidence for evaluating the implementation effects of regional digital economy policies but also offers valuable insights for optimizing policy design and promoting corporate digital transformation.

Keywords

Digital Economy, Corporate Digital Transformation, National Digital

Economy Innovation and Development Pilot Zone, Policy Evaluation, Difference-in-Differences Model

1. Introduction

The global economy is currently undergoing profound changes centered on digital technology, with the digital economy becoming a key force reshaping industrial structures and national competitiveness. The digital economy is a new economic form that takes data as the key production factor, modern information networks as the main carrier, and reshapes the economic development and governance model through the deep integration and application of information and communication technologies. Against this backdrop, the digital transformation of enterprises (that is, the process in which enterprises systematically reshape business processes, organizational structures and even business models by using new-generation digital technologies) has shifted from an "optional" to a "compulsory question" concerning survival and development.

To adapt to this trend, since the 18th National Congress of the Communist Party of China, China has elevated digital development to a national strategic level. From the construction of "Internet Plus" to "Digital China", a series of top-level designs have provided clear policy guidance for the digital transformation of enterprises. Among them, the establishment of the "National Digital Economy Innovation and Development Pilot Zone" (hereinafter referred to as the "Pilot Zone") is a key policy tool for promoting the deep integration of the digital economy and the real economy. This policy aims to break through institutional and mechanism obstacles in areas such as data element circulation, industrial digital transformation, and digital governance through regional pilot projects, and to form replicable and scalable experiences. Therefore, scientifically assessing the actual effect of the pilot zone policies on the digital transformation of enterprises is of great theoretical and practical significance for optimizing the national digital economy strategy and enhancing the precision of policies.

Although existing research generally recognizes the significant role of policies in promoting the digital transformation of enterprises, there are still some gaps. Firstly, most of the existing research focuses on macroeconomic impacts or individual micro enterprises. However, there is still a lack of in-depth analysis of how the "meso" policy carriers that connect the macro and micro (such as pilot zones) systematically affect the digital ecosystem of enterprises and their internal mechanisms of action. Secondly, the assessment of policy effects is often constrained by the difficulty in accurately measuring the degree of digital transformation of enterprises. Traditional measurement methods either rely on a single index or adopt dictionary methods, which have problems such as incomplete coverage and unclear semantics (Jin et al., 2024).

Based on this, this paper mainly focuses on whether the policies of national

digital economy innovation and development pilot zones can promote the digital transformation of enterprises and how to promote it, especially the heterogeneity issues that affect the effects. Firstly, based on the text data such as the annual reports and financial reports of listed companies, as well as the financial data, extract the relevant terms and financial indicators for digital transformation. By combining principal component analysis and factor analysis, a multi-dimensional comprehensive measurement index for enterprise digital transformation is constructed. Then, based on the establishment of the National Digital Economy Innovation and Development pilot zones in 2019 and 2025, taking the establishment of the pilot zones as the standard natural experiment, a multi-period difference-in-differences (DID) model was constructed to empirically test the impact of this policy on the digital transformation of enterprises in the pilot provinces. Finally, through the analysis of different policy batches and the characteristics of different enterprises, the dynamic changes and heterogeneous manifestations of policy effects are deeply explored.

The potential contributions of this paper are mainly reflected in three aspects: First, in terms of measurement methods, by comprehensively utilizing diverse information such as text analysis and financial indicators, a new index for enterprise digital transformation has been constructed, providing a more reliable measurement tool for related research. Second, in terms of research perspective, it focuses on the "experimental zone", a key meso-level policy carrier, bridging the gap between macro policy research and micro enterprise behavior research, and deepening the theoretical understanding of policy-driven digital transformation. Thirdly, in terms of practical significance, the research conclusions of this paper can provide decision-making references for government departments to optimize regional innovation policies and enhance policy accuracy. At the same time, it can also offer valuable inspirations for enterprises on how to effectively utilize policy dividends and choose appropriate transformation paths.

2. Institutional Background of the Pilot Zone

To implement the strategic arrangements of the CPC Central Committee and the State Council for developing the digital economy and address key issues in its development, the National Development and Reform Commission (NDRC) and the Cyberspace Administration of China (CAC) jointly issued the "Implementation Plan for National Digital Economy Innovation and Development Pilot Zones" in October 2019. And the creation work was officially launched at the 6th World Internet Conference on October 20, 2019. The first batch of experimental zones covers six regions including Hebei Province (Xiongan New Area), Zhejiang Province, Fujian Province, Guangdong Province, Chongqing Municipality and Sichuan Province. Its core task is to carry out reform experiments around key links such as the efficient allocation of data elements, digital industrialization, industrial digitalization, digital governance and new infrastructure, aiming to form a number of replicable and promotable typical practices and play a leading and ex-

emplary role.

The first batch of experimental zones have formulated specific work plans based on their own advantages. The Guangdong Provincial Plan (released in November 2020) relies on the Guangdong-Hong Kong-Macao Greater Bay Area and focuses on exploring the efficient allocation and rule alignment of innovative elements in the digital economy. The Fujian Provincial Plan (released in March 2021) proposed that by 2022, the added value of the digital economy should account for more than 50% of the GDP, and focused on characteristic fields such as the "Digital Silk Road" and smart ocean.

With the deepening of practice, the scope of the experimental zone has also been dynamically adjusted. According to the approval of the National Data Bureau in March 2025, the new round of pilot zone construction will be carried out in seven regions including Tianjin, Shanghai, Jiangsu Province, and the first batch of Hebei Province (Xiongan New Area), Zhejiang Province, Guangdong Province and Sichuan Province. Compared with the 2019 list, Fujian Province and Chongqing Municipality have withdrawn, while Tianjin, Shanghai and Jiangsu Province have joined as new highlands for the development of the digital economy. This adjustment reflects the optimization and deepening of the strategic layout for the development of the digital economy at the national level based on the summary of previous experiences.

3. Literature Review and Research Hypothesis

3.1. Measurement of Enterprise Digital Transformation

Accurately measuring the level of enterprise digital transformation is the foundation of relevant empirical research. Existing literature primarily adopts three methods: first, the input method, which uses corporate investments in digital-related fixed assets, R&D, or intangible assets as proxy variables (Pei, 2025). Second, the survey method, which assesses the extent of digital strategy and practices by surveying corporate executives or employees. Third, the text analysis method, which constructs indicators based on the frequency of keywords such as "artificial intelligence", "big data", and "cloud computing" in public texts like annual reports of listed companies (Wu et al., 2021). However, these methods have limitations. The input method struggles to distinguish between general investments and specific digital investments; the survey method is constrained by limited sample sizes and subjective biases; while the traditional dictionary method, though widely used, faces issues such as incomplete keyword coverage and semantic misjudgment. Recently, scholars have begun to utilize machine learning and large language models to enhance measurement accuracy (Jin et al., 2024), providing methodological references for this study.

3.2. The Impact of Digital Economy Policies on Corporate Digital Transformation

Government policies play a crucial role in promoting the digital transformation

of enterprises. From a theoretical perspective, the policies of the pilot zone influence enterprise behavior through three core mechanisms:

1) Resource allocation and incentive mechanism: The pilot zone has launched a policy combination including special funds, tax preferences, and financing support, directly reducing the cost and risk of digital transformation for enterprises, while alleviating their financing constraints (Dan et al., 2024; Pei, 2025). Such policies can also gather innovative elements such as technology, capital and talents, forming a full-chain support system of "infrastructure - capacity building - application innovation", especially helping small and medium-sized enterprises break through resource bottlenecks (Zhang et al., 2025).

2) Institutional innovation and environmental optimization mechanism: The pilot zone creates an inclusive environment for the digital development of enterprises through institutional innovation measures such as relaxing market access, optimizing the regulatory framework, and establishing a data trading market, thereby reducing transaction costs and policy uncertainties (Shan et al., 2025). A clear, stable and forward-looking regulatory system can significantly enhance enterprises' willingness to invest in digital transformation (Zheng et al., 2021).

3) Technology diffusion and industrial collaboration mechanism: The industrial agglomeration effect within the experimental zone, through means such as infrastructure sharing, technology spillover, and talent flow, accelerates the penetration of digital technology into various industries (Zeng & Bao, 2025). Under the policy support of the experimental zone, platform enterprises have constructed the "platform + ecosystem" model to promote the collaborative transformation of the entire value chain (Zhang et al., 2025).

3.3. Research Hypotheses

Based on the above theoretical logic and institutional background, this paper puts forward the following research hypotheses:

Hypothesis 1 (H1): The National Digital Economy Innovation and Development Pilot Zone policy can significantly promote the digital transformation of enterprises in the pilot regions.

Digital transformation is a dynamic process, typically following the evolutionary logic of "technology application - process optimization - business model innovation" (Yin & Song, 2024). The initial impact of the policy may be more reflected in incentivizing firms to engage in digital practices and investments, while the translation of these investments into actual output and market value takes longer. Therefore, we expect the policy effect to vary across different dimensions.

Hypothesis 2 (H2): The impact of the Pilot Zone policy on corporate digital transformation exhibits a dynamic characteristic of "practice before output," meaning the policy's promoting effect on the practical aspects of corporate digitalization is stronger than its impact on the output level of digitalization.

The intensity and persistence of policy implementation are also crucial. As the Pilot Zone construction deepens and policy tools enrich, their guidance and support for enterprises will strengthen, and the policy's spillover effects may become apparent, for instance, transmitting from internal corporate practices to external capital market recognition.

Hypothesis 3 (H3): As the Pilot Zone policy deepens (e.g., continuous advancement from the first to subsequent batches), its promoting effect on corporate digital transformation will strengthen and may generate broader spillover effects.

4. Research Design

4.1. Model Specification

To evaluate the impact of the National Digital-Economy Innovation and Development Pilot-Zone policy on enterprise digital transformation, we treat the establishment of the zones as a quasi-natural experiment and estimate a multi-period difference-in-differences (DID) model. The baseline specification is as follows:

$$composite\_index_{it} = \alpha + \beta Treat_i \times Post_t + \gamma X_{it} + \mu_i + \delta_t + \varepsilon_{it}$$

where i and t denote firm and year, respectively. μ_i represents firm-specific fixed effects that control for time-invariant heterogeneity across firms; δ_t denotes year fixed effects that absorb common macroeconomic shocks and time trends; and ε_{it} is the idiosyncratic error term.

$composite\_index_{it}$: the dependent variable, measuring the comprehensive digital-transformation score of firm i in year t.

$Treat_i \times Post_t$: the core explanatory variable, an interaction term between the policy dummy variable and the policy implementation time dummy variable. $Treat_i$ indicates whether the firm is located in a Pilot Zone province (1 if yes, 0 otherwise). $Post_t$ eindicates the policy implementation period (1 for years after policy implementation, 0 otherwise). Its coefficient β measures the net effect of policy implementation and is the focus of this study.

X_{it} : a vector of time-varying firm-level control variables.

4.2. Variable Definitions

4.2.1. Dependent Variable

The dependent variable is the composite digital-transformation index (composite_index). Following Jin et al. (2024) and Wu et al. (2021), we extract annual keyword frequencies related to AI, big data, cloud computing, blockchain, IoT, etc., from listed firms' annual reports, combine them with the share of digital-related intangible assets and analysts' attention to corporate digital strategy, and construct a single composite index via principal-component analysis (PCA) and factor analysis (FA).

To test H2, we define the word frequency indicator (annual_wfre) as the digital practice index, focusing more on reflecting the digital actions and investments disclosed in annual reports. Furthermore, we define the intangible assets ratio

(dtia_ratio) and analyst attention (analysis_wfre) as the digital output index, focusing more on reflecting the outcomes of digital transformation.

4.2.2. Core Independent Variables

Based on the relevant policies of the "National Digital Economy Innovation and Development Pilot Zone," we define two sets of core explanatory variables to examine the impact of different policy batches.

1) Policy variable 1 of the pilot zone (Di_Ec): For the first batch of pilot zones in 2019, when the province where the enterprise is located is Zhejiang, Fujian, Guangdong, Chongqing, or Sichuan and the year is 2019 or later, the value is 1; otherwise, it is 0. The number of enterprises in Hebei Province (Xiongan New Area) is too small to be considered.

2) Policy variable 2 of the pilot zone (Di_Ec2): For the adjusted pilot zones in 2025, examine whether there are spillover effects of the pilot zone policies in these provinces looking back to 2019. When the province where the enterprise is located is Tianjin, Shanghai, Jiangsu, Zhejiang, Guangdong or Sichuan and the year is 2019 or later, the value is 1; otherwise, it is 0. The number of enterprises in Hebei Province (Xiongan New Area) is too small to be considered.

4.2.3. Control Variables

To mitigate omitted variable bias, this paper selects a series of firm-level control variables, including: Firm size (Size, natural logarithm of total assets), financial leverage (Lev, total debt/total assets), profitability (ROE, return on equity), firm age (FirmAge, years since IPO), ownership concentration (Top1, shareholding ratio of the largest shareholder), CEO duality (Dual, whether the chairman and CEO are the same person), and book-to-market ratio (BM).

4.3. Data Sources

The research sample consists of Chinese A-share listed companies from 2015 to 2023. Data related to digital transformation comes from the CNRDS database on listed companies' digital transformation. Corporate annual reports and financial data are sourced from the CSMAR database. The total number of observations is 28,355.

5. Empirical Results and Analysis

5.1. Date Description

Figure 1 shows the annual average change trend of the comprehensive Index of enterprise digital transformation (Index 1 and Index 2) from 2015 to 2023. It can be seen that both indices were at a relatively low level and grew slowly before the policy was implemented in 2019. Since 2020, the index has entered a positive range and shown an accelerating upward trend, which is highly consistent with the implementation time point of the pilot zone policy. This initially indicates that the policy may have played a promoting role in the digital transformation of enterprises.

5.2. Benchmark Regression Analysis

Table 1 and Table 2 report the baseline regression results for the impact of the 2019 Pilot Zone policy (Di_Ec). Table 1 shows results without control variables, and Table 2 shows results with control variables added.

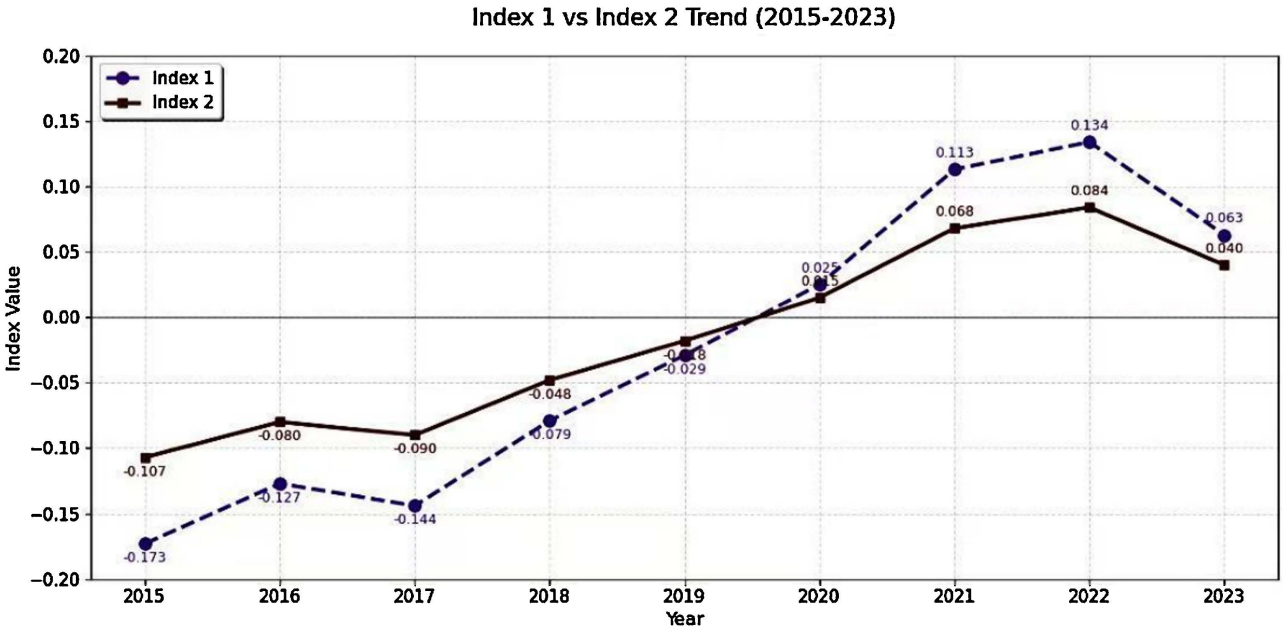

Figure 1. Trend of the composite enterprise digital-transformation index.

Table 1. Regression result for 2019 without control variables.

	(1) composite_index_1	(2) composite_index_2	(3) annual_wfre	(4) dtia_ratio	(5) analysis_wfre
Di_Ec	0.165***	0.108***	19.067***	0.003	0.125
	(8.283)	(9.175)	(15.600)	(0.682)	(0.038)
_cons	−0.037***	−0.023***	51.241***	0.148***	78.102***
	(−8.832)	(−9.123)	(199.991)	(150.547)	(114.524)
R^2	0.007	0.009	0.031	0.000	0.000
adj. R^2	0.007	0.009	0.031	0.000	−0.000
F	68.611	84.174	243.369	0.466	0.001
N	28,355	28,355	28,355	28,355	28,355

t statistics in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table 2. Regression result for 2019 with control variables

	(1) composite_index_1	(2) composite_index_2	(3) annual_wfre	(4) dtia_ratio	(5) analysis_wfre
Di_Ec	0.040*	0.026**	2.720**	−0.001	4.648
	(1.881)	(2.062)	(2.171)	(−0.216)	(1.264)

Continued

ROE	−0.001	−0.001	−0.437**	0.002*	0.047
	(−0.316)	(−0.907)	(−2.391)	(1.815)	(0.099)
Lev	−0.155**	−0.094**	−8.848**	−0.009	−16.230
	(−2.240)	(−2.311)	(−2.290)	(−0.493)	(−1.431)
Size	0.187***	0.127***	15.399***	−0.016***	19.943***
	(8.008)	(9.182)	(11.516)	(−2.719)	(5.741)
FirmAge	0.238***	0.148***	46.372***	0.053***	−55.143***
	(3.315)	(3.458)	(11.256)	(3.531)	(−4.812)
Dual	0.003	0.003	2.247*	0.000	−3.898
	(0.173)	(0.272)	(1.841)	(0.111)	(−1.261)
Top1	−0.211	−0.144	−25.128**	0.010	−3.760
	(−1.301)	(−1.500)	(−2.517)	(0.290)	(−0.183)
BM	0.003	0.002	0.470**	0.001***	−0.487
	(1.035)	(0.937)	(2.490)	(2.981)	(−1.189)
_cons	−4.788***	−3.208***	−418.315***	0.356***	−193.522**
	(−10.244)	(−11.625)	(−16.405)	(3.064)	(−2.531)
R^2	0.030	0.037	0.122	0.004	0.004
adj. R^2	0.030	0.037	0.122	0.003	0.004
F	25.890	31.613	97.025	3.302	6.213
N	28,276	28,276	28,276	28,276	28,276

t statistics in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

In Table 1, the coefficients of Di_Ec for the two digital transformation composite indices (composite_index_1 and composite_index_2) are 0.165 and 0.108 respectively, and both are significantly positive at the 1% level. This indicates that, compared with non-pilot areas, the policies of the pilot zone have significantly enhanced the digital transformation level of enterprises in the pilot areas. In Table 2, after adding a series of control variables at the enterprise level, although the coefficient of Di_Ec decreased (0.040 and 0.026 respectively), it was still significant at the 10% and 5% levels, which confirmed the robustness of the policy effect after controlling for enterprise heterogeneity. Therefore, it is assumed that H1 is supported.

Further analysis of the sub-indicators shows that the policy has the most significant boosting effect on the frequency of digital vocabulary in annual reports (annual_wfre) (with a coefficient of 2.720, which is significant at the 5% level), while having no significant impact on the proportion of intangible assets (dtia_ratio) and analyst attention (analysis_wfre). This indicates that the short-term effect of the policy mainly lies in encouraging enterprises to proactively carry out digital

practices and disclose them to the public, but it has not yet been effectively transmitted to the substantive optimization of the asset structure or widely recognized by the capital market. This discovery strongly supports Hypothesis H2, that is, the policy effect has a structural differentiation of "practice first, then output".

The results of controlling variables also conform to economic intuition. The coefficients of enterprise Size (Size) and enterprise FirmAge (FirmAge) are significantly positive, indicating that large and mature enterprises have more advantages in terms of resources and experience, and are more likely to respond to policies and promote digitalization. The coefficient of financial leverage (Lev) is significantly negative, highlighting that financial constraints are a major obstacle to the digital transformation of enterprises.

5.3. Spillover Effects of the Pilot-Zone Policy

To test Hypothesis H3, this paper utilizes the Pilot Zones approved by the National Data Administration in March 2025 (particularly the newly added Tianjin, Shanghai, and Jiangsu). We examine retrospectively from 2019 whether there were spillover effects from the Pilot Zone policy. Table 3 and Table 4 use the variable Di_Ec2, representing the 2025 Pilot Zones looked back from 2019. Table 3 shows results without control variables, and Table 4 shows results with control variables added.

Table 3. Regression result for 2025 without control variables.

	(1) composite_index_1	(2) composite_index_2	(3) annual_wfre	(4) dtia_ratio	(5) analysis_wfre
Di_Ec2	0.167***	0.109***	18.920***	0.004	0.834
	(9.947)	(10.928)	(18.734)	(0.955)	(0.310)
_cons	−0.054***	−0.034***	49.403***	0.148***	77.870***
	(−10.388)	(−10.886)	(158.610)	(123.793)	(93.783)
R^2	0.010	0.013	0.043	0.000	0.000
adj. R^2	0.010	0.013	0.043	0.000	−0.000
F	98.938	119.413	350.954	0.912	0.096
N	28,355	28,355	28,355	28,355	28,355

t statistics in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table 4. Regression result for 2025 with control variables.

	(1) composite_index_1	(2) composite_index_2	(3) annual_wfre	(4) dtia_ratio	(5) analysis_wfre
Di_Ec2	0.050***	0.032***	2.906***	−0.000	6.268*
	(2.599)	(2.767)	(2.647)	(−0.064)	(1.871)
ROE	−0.001	−0.001	−0.435**	0.002*	0.049
	(−0.319)	(−0.939)	(−2.458)	(1.815)	(0.106)

Continued

Lev	−0.154**	−0.093**	−8.797**	−0.009	−16.185
	(−2.234)	(−2.304)	(−2.281)	(−0.496)	(−1.426)
Size	0.186***	0.126***	15.346***	−0.016***	19.789***
	(7.968)	(9.140)	(11.475)	(−2.724)	(5.688)
FirmAge	0.205***	0.127***	44.809***	0.053***	−59.823***
	(2.754)	(2.878)	(10.495)	(3.432)	(−4.898)
Dual	0.003	0.003	2.253*	0.000	−3.874
	(0.182)	(0.281)	(1.848)	(0.112)	(−1.254)
Top1	−0.211	−0.145	−25.222**	0.010	−3.654
	(−1.299)	(−1.499)	(−2.525)	(0.296)	(−0.177)
BM	0.003	0.002	0.469**	0.001***	−0.485
	(1.030)	(0.932)	(2.471)	(2.988)	(−1.176)
_cons	−4.669***	−3.135***	−412.754***	0.359***	−177.061**
	(−9.999)	(−11.366)	(−16.035)	(3.090)	(−2.274)
R^2	0.030	0.037	0.122	0.004	0.005
adj. R^2	0.030	0.037	0.122	0.003	0.004
F	26.171	31.857	97.030	3.255	6.359
N	28,276	28,276	28,276	28,276	28,276

t statistics in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Comparing the results in Table 2 and Table 4 clearly reveals the spill-over effects of the pilot-zone policy. In Table 4, the coefficients of Di_Ec2 on the two composite indices (0.050 and 0.032) are higher than those of Di_Ec in Table 2 (0.040 and 0.026), and the significance levels are also higher, indicating that the policy has indeed generated positive spill-over effects, providing strong evidence for Hypothesis H3.

6. Research Conclusions and Policy Implications

Based on a newly constructed firm-level digital transformation index, this paper empirically evaluates the implementation effects of the National Digital Economy Innovation and Development Pilot-Zone policy. The main conclusions are as follows:

The main research conclusions are as follows: 1) The Pilot Zone policy, as an important regional digital economy strategy, indeed serves as an "experimental field", significantly promoting the digital transformation process of enterprises in the pilot areas. 2) The policy effect is not evenly distributed across all dimensions of transformation. Its short-term impact is more reflected in incentivizing firms to undertake digital "practices" and enhance information disclosure, while achiev-

ing value at the "output" level, such as asset structure optimization and capital market recognition, requires more time and stronger policy intensity. 3) The deepening and strengthening of the policy can generate positive spillover effects.

Based on the above conclusions, this paper puts forward the following policy suggestions: 1) Adhere to and optimize the policies of the pilot zones: The pioneering and experimental role of the pilot zones should continue to be played, and the scope and task priorities of the pilot zones should be dynamically adjusted according to the development stage. Successful experiences should be summarized in a timely manner and promoted nationwide. 2) Enhance the long-term and stable nature of policies: Digital transformation is a long-term systematic project. Policies should maintain continuity and stability, providing enterprises with clear and reliable expectations and strengthening their confidence in long-term investment. At the same time, efforts should be made to strengthen the guidance of the capital market and establish and improve the assessment system for the digital value of enterprises. 3) Fostering a favorable digital ecosystem: The government should focus on building an open and collaborative digital ecosystem. By establishing public data platforms, improving data trading rules, and cultivating compound digital talents, it should provide comprehensive environmental support for enterprises' digital transformation.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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