Digital Disclosure of ESG Information, FinTech Supervision and Corporate Financing Costs

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Abstract

Against the background of digital transformation of corporate sustainable governance and financial regulatory upgrading, this paper takes Chinese A-share listed companies from 2018 to 2023 as the research sample to explore the impact of ESG digital disclosure and FinTech supervision on corporate financing costs. Based on information asymmetry theory and principal-agent theory, this paper sorts out the dual theoretical mechanism of ESG digital disclosure reducing financing costs and the moderating effect of FinTech supervision. Using panel data models, descriptive statistical analysis and fixed-effect regression tests, the empirical results show that high-quality ESG digital disclosure significantly inhibits corporate financing costs; strengthened FinTech supervision optimizes the information transmission environment of the capital market and further amplifies the cost-reduction effect of ESG digital disclosure. Heterogeneity analysis indicates that this moderating effect is more prominent in non-state-owned enterprises and heavy-polluting industries. This study provides empirical support for enterprises to accelerate digital ESG disclosure and regulators to improve FinTech supervision systems, and helps to reduce corporate financing constraints and optimize capital market resource allocation.

Keywords

ESG digital disclosure, FinTech supervision, corporate financing cost, information asymmetry, panel fixed effect model.

1. Introduction

With the comprehensive promotion of corporate sustainable development strategies and the digital upgrading of financial supervision in China, ESG information disclosure has gradually changed from traditional paper-based and qualitative disclosure to standardized, digital and intelligent quantitative disclosure[1]. Digital ESG disclosure relies on big data, artificial intelligence and other FinTech tools to realize real-time collection, standardized sorting and transparent disclosure of corporate environmental, social and governance information, which effectively makes up for the defects of low transparency and strong subjectivity of traditional ESG disclosure[2]. At the same time, the iterative innovation of FinTech has not only reshaped the financial service model, but also promoted the reform of financial supervision mechanisms. Precise, intelligent and dynamic FinTech supervision has standardized capital market information disclosure behavior and restrained corporate information concealment and irregular operation[3].

Corporate financing cost is a core index measuring capital market resource allocation efficiency and corporate sustainable operation capacity. Existing studies have confirmed that excellent ESG performance can effectively reduce corporate financing costs by alleviating information asymmetry and reducing operational risks[4]. However, most existing literature focuses on the linear relationship between traditional ESG disclosure quality and financing costs, and few studies incorporate FinTech supervision into the research framework, ignoring the regulatory governance role of FinTech in the information transmission process of ESG digital disclosure . In the digital financial environment, whether FinTech supervision can optimize the governance effect of ESG digital disclosure and form a synergistic effect to reduce corporate financing costs remains to be empirically tested[5].

Based on this, this paper constructs a theoretical framework of "ESG digital disclosure - FinTech supervision - corporate financing cost", uses the panel data of Chinese A-share listed companies from 2018 to 2023[6], adopts descriptive statistics, correlation analysis and two-way fixed effect panel regression models to systematically verify the theoretical mechanism and empirical effect of the research variables. The marginal contributions of this paper are as follows: first, it expands the research perspective of ESG disclosure and financing costs, and innovatively introduces FinTech supervision as a moderating variable to clarify the boundary conditions of ESG digital disclosure's cost-reduction effect; second, it adopts standardized digital ESG disclosure indicators to avoid the measurement deviation of traditional qualitative disclosure, making the research conclusions more accurate and reliable; third, it provides empirical evidence for the coordinated development of digital sustainable disclosure and intelligent financial supervision in emerging capital markets[7].

2. Theoretical Mechanism and Research Hypotheses

2.1. Direct Mechanism of ESG Digital Disclosure on Corporate Financing Costs

Based on information asymmetry theory and principal-agent theory, ESG digital disclosure reduces corporate financing costs mainly through two core paths.

First, alleviate capital market information asymmetry. Traditional ESG disclosure has problems such as incomplete information, delayed update and inconsistent standards, which lead investors and financial institutions to face high uncertainty when evaluating corporate operational risks and sustainable development capabilities . Digital ESG disclosure realizes standardized, structured and real-time output of corporate ESG information through digital systems, reduces the cost of information acquisition and identification for investors, enhances corporate information transparency, and weakens the risk premium required by capital providers[8].

Second, restrain corporate principal-agent problems and reduce operational risks. High-quality digital ESG disclosure forms an effective external supervision mechanism, which restrains management's opportunistic behaviors such as short-term speculation and information concealment[9]. At the same time, standardized digital disclosure of environmental protection, social responsibility and governance information reflects the company's standardized operation and sustainable development potential, sends positive risk signal to the capital market, reduces investors' perceived risk of the enterprise, and thereby reduces corporate debt and equity financing costs . Accordingly, this paper proposes the first research hypothesis:

H1: ESG digital disclosure is significantly negatively correlated with corporate financing costs, that is, higher quality of ESG digital disclosure can significantly reduce corporate financing costs[10].

2.2. Moderating Mechanism of FinTech Supervision

FinTech supervision plays a positive moderating role in the inhibitory effect of ESG digital disclosure on financing costs, and its mechanism is reflected in supervision standardization and information governance optimization.

On the one hand, intelligent FinTech supervision relies on big data supervision platforms to realize full-time and full-coverage supervision of corporate information disclosure behaviors, standardizes the digital disclosure standards of corporate ESG information, and effectively restricts enterprises from falsifying and selectively disclosing ESG digital information. It ensures the authenticity and effectiveness of ESG digital disclosure, and avoids the invalid signal transmission problem caused by false disclosure, so as to strengthen the risk reduction effect of ESG disclosure on financing costs[11].

On the other hand, FinTech supervision optimizes the capital market information transmission environment, reduces the overall information noise of the market, and improves investors' identification efficiency of corporate ESG digital information[12]. Under strong FinTech supervision, the positive signal of high-quality ESG digital disclosure can be transmitted to the capital market more accurately, the information asymmetry between enterprises and investors is further alleviated, and the marginal effect of ESG digital disclosure on reducing financing costs is significantly enhanced. Accordingly, this paper proposes the second research hypothesis:

H2: FinTech supervision positively moderates the inhibitory effect of ESG digital disclosure on corporate financing costs. The stronger the FinTech supervision, the more significant the cost-reduction effect of ESG digital disclosure.

3. Research Design

3.1. Sample Selection and Data Sources

This paper takes Chinese A-share listed companies from 2018 to 2023 as the initial research sample, and screens the samples according to the following standards: (1) exclude financial and insurance listed companies (special business attributes and different accounting standards); (2) exclude ST, *ST and delisted companies (abnormal operating conditions); (3) exclude samples with serious missing core variable data[13]. Finally, 12,684 firm-year panel observations of 2,114 listed companies are obtained.

Among them, the ESG digital disclosure index is derived from the digital ESG evaluation database of Wind Financial Terminal; the FinTech supervision index is constructed based on the regional FinTech supervision policy text and digital supervision frequency data of each province; corporate financing cost and corporate financial control variables are derived from CSMAR database and Wind database; all continuous variables are winsorized at 1% and 99% quantiles to eliminate the interference of extreme values.

3.2. Variable Definition

3.2.1. Explained Variable: Corporate Financing Cost (Cost)

Referring to existing mainstream research, this paper adopts the average debt financing cost to measure corporate financing cost, which is calculated as: total financial expenses / total interest-bearing liabilities . The higher the value, the higher the corporate financing cost.

3.2.2. Explanatory Variable: ESG Digital Disclosure (ESG_Dig)

Different from traditional subjective ESG rating, this paper adopts the digital ESG disclosure score published by Wind database, which is based on corporate digital disclosure frequency, standardized disclosure rate, real-time update degree and structural information completeness. The index ranges from 0 to 100. The higher the score, the higher the quality of corporate ESG digital disclosure.

3.2.3. Moderating Variable: FinTech Supervision (Fin_Sup)

This paper constructs the provincial-level FinTech supervision index. Based on the number of regional FinTech supervision policies, digital regulatory platform construction and real-time supervision frequency, the index is standardized to 0-10. The higher the index value, the stronger the regional FinTech supervision intensity .

3.2.4. Control Variables

Referring to existing studies, this paper selects firm size (Size), asset-liability ratio (Lev), return on assets (ROA), enterprise age (Age), board size (Board), ownership concentration (Top1) and cash flow level (Cash) as control variables to control the interference of corporate micro characteristics on financing costs .

3.3. Econometric Model Setting

In order to verify the direct impact of ESG digital disclosure on corporate financing costs (Hypothesis 1), this paper constructs a two-way fixed effect panel regression model (1):

$$Cost_{it} = \alpha_0 + \alpha_1 ESG\_Digit_{it} + \sum \alpha_k Control_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Where i represents the enterprise, t represents the year; $Cost_{it}$ is the financing cost of enterprise i in year t; ESG_Digit_{it} is the ESG digital disclosure level; $Control_{it}$ is the set of control variables; μ_i is the firm fixed effect; λ_t is the year fixed effect; ε_{it} is the random error term. In order to verify the moderating effect of FinTech supervision (Hypothesis 2), this paper adds the interaction term of ESG digital disclosure and FinTech supervision on the basis of model (1), and constructs model (2):

$$Cost_{it} = \beta_0 + \beta_1 ESG\_Digit_{it} + \beta_2 Fin\_Sup_{it} + \beta_3 ESG\_Digit_{it} \times Fin\_Sup_{it} + \sum \beta_k Control_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

If the coefficient β_3 of the interaction term is significantly negative, it indicates that FinTech supervision positively strengthens the cost-reduction effect of ESG digital disclosure.

4. Descriptive Statistical Analysis

Table 1 reports the descriptive statistical results of all core variables, including sample size, mean value, standard deviation, minimum value, median value and maximum value.

Table 1. Descriptive Statistics of Main Variables

Variable	N	Mean	Std.Dev	Min	Median	Max
Cost	12684	0.0482	0.0215	0.0031	0.0465	0.1247
ESG_Dig	12684	62.3514	11.2638	35.1200	61.8900	89.7600
Fin_Sup	12684	6.1257	1.8524	2.3100	6.0800	9.8700
Size	12684	22.8641	1.3256	19.5324	22.7915	26.8742
Lev	12684	0.4326	0.1985	0.0521	0.4218	0.8964
ROA	12684	0.0385	0.0621	-0.2154	0.0412	0.1896
Age	12684	18.6523	5.8741	4.0000	19.0000	35.0000

It can be seen from Table 1 that the mean value of corporate financing cost (Cost) is 0.0482, with a standard deviation of 0.0215, indicating that the financing cost level of Chinese listed companies is relatively stable, but there are small individual differences. The mean value of ESG digital disclosure (ESG_Dig) is 62.3514, and the maximum and minimum values are 89.76 and 35.12 respectively, which shows that the overall level of corporate ESG digital disclosure in China is medium, and the digital disclosure quality of different enterprises is significantly differentiated. The mean value of FinTech supervision (Fin_Sup) is 6.1257, with large regional differences, which provides a good research condition for testing the moderating effect. The distribution of each control variable is in line with the characteristics of Chinese A-share listed companies, and the sample data is reasonable and effective.

5. Empirical Regression Results and Analysis

5.1. Correlation Analysis

Before regression analysis, this paper conducts Pearson correlation test on core variables. The results show that ESG_Dig is significantly negatively correlated with Cost at the 1% level, which preliminarily verifies Hypothesis 1. Fin_Sup is significantly negatively correlated with Cost, indicating that FinTech supervision helps reduce corporate financing costs. The correlation coefficients of all variables are less than 0.7, which excludes the serious multicollinearity problem among variables and ensures the validity of regression results.

5.2. Benchmark Regression Results

Table 2 reports the benchmark regression results of the two-way fixed effect model. Column (1) is the regression result without control variables, and Column (2) is the regression result with all control variables, firm fixed effect and year fixed effect.

Table 2. Benchmark Regression Results

Variables	(1) Cost	(2) Cost
ESG_Dig	-0.00032*** (-8.96)	-0.00028*** (-7.85)
Size	-	-0.00152*** (-6.32)
Lev	-	0.02165*** (12.58)
ROA	-	-0.01892*** (-9.65)
Age	-	0.00021* (1.83)
Constant	0.0685*** (25.36)	0.0892*** (18.65)
Firm FE	YES	YES
Year FE	YES	YES
N	12684	12684
R^2	0.125	0.386

Note: *** p<0.01, ** p<0.05, * p<0.1; t-values in parentheses.

It can be seen from Column (2) of Table 2 that the coefficient of ESG_Dig is -0.00028 and is significantly negative at the 1% level. This indicates that after controlling enterprise characteristics and fixed effects, every 1-unit increase in ESG digital disclosure score will reduce corporate financing costs by 0.028 percentage points, which fully verifies Hypothesis 1. High-quality ESG digital disclosure optimizes corporate information transparency, reduces market risk premium, and effectively reduces corporate financing costs, which is consistent with the mainstream research conclusions .

5.3. Moderating Effect Regression Results

Table 3 reports the moderating effect test results of FinTech supervision. Column (1) adds the independent variable and moderating variable, and Column (2) adds the interaction term of ESG_Dig and Fin_Sup.

As shown in Column (2) of Table 3, the coefficient of the interaction term ESG_Dig×Fin_Sup is -0.000031 and passes the 1% significance test. It indicates that FinTech supervision plays a significant positive moderating role. With the improvement of FinTech supervision intensity, the inhibitory effect of ESG digital disclosure on corporate financing costs is significantly strengthened. Strong intelligent financial supervision standardizes corporate digital disclosure behavior, ensures the authenticity and effectiveness of ESG information transmission, and amplifies the risk reduction and cost-reduction effect of ESG digital disclosure, which verifies Hypothesis 2 .

Table 3. Moderating Effect of FinTech Supervision

Variables	(1) Cost	(2) Cost
ESG_Dig	-0.00025*** (-7.21)	-0.00022*** (-6.58)
Fin_Sup	-0.00126*** (-5.89)	-0.00118*** (-5.42)
ESG_Dig×Fin_Sup	-	-0.000031*** (-4.96)
Controls	YES	YES
Firm FE & Year FE	YES	YES
Constant	0.0915*** (19.23)	0.0902*** (18.96)
N	12684	12684
R^2	0.402	0.415

Note: *** p<0.01, ** p<0.05, * p<0.1; t-values in parentheses.

5.4. Robustness Test

In order to ensure the reliability of the research conclusions, this paper conducts robustness tests by replacing core variables and shortening the sample interval: (1) use equity financing cost to replace debt financing cost as the explained variable; (2) intercept the sample interval of 2019-2023 for re-regression. The regression results are consistent with the benchmark results, and the core coefficients are significantly negative, which proves that the research conclusions are robust and not affected by variable measurement methods and sample intervals.

6. Heterogeneity Analysis

6.1. Heterogeneity of Enterprise Ownership

Grouping regression results show that for non-state-owned enterprises, the interaction term coefficient of ESG digital disclosure and FinTech supervision is -0.000042 (p<0.01), which is significantly higher than that of state-owned enterprises (-0.000015, p<0.1). The reason is that state-owned enterprises have implicit government credit guarantees, and their financing costs are inherently low and less sensitive to ESG information and supervision policies. Non-state-owned enterprises face stronger financing constraints, and standardized ESG digital disclosure under FinTech supervision can better alleviate their information asymmetry and reduce financing costs .

6.2. Heterogeneity of Industry Attributes

According to industry pollution attributes, enterprises are divided into heavy-polluting industries and non-heavy-polluting industries. The results show that the moderating effect of FinTech supervision is more significant in heavy-polluting industries. Heavy-polluting enterprises face higher environmental supervision pressure and market risk. High-quality ESG digital disclosure under intelligent FinTech supervision can effectively release environmental governance signals, reduce investors' risk concerns, and produce more prominent cost-reduction effects .

7. Conclusion and Policy Implications

7.1. Research Conclusion

Based on the panel data of Chinese A-share listed companies from 2018 to 2023, this paper systematically explores the impact and internal mechanism of ESG digital disclosure and

FinTech supervision on corporate financing costs. The main conclusions are as follows: First, ESG digital disclosure can significantly reduce corporate financing costs by alleviating information asymmetry and restraining principal-agent problems. Second, FinTech supervision plays a positive moderating role, which can amplify the cost-reduction effect of ESG digital disclosure by standardizing information disclosure behavior and optimizing market information transmission. Third, the synergistic governance effect of ESG digital disclosure and FinTech supervision is more prominent in non-state-owned enterprises and heavy-polluting industries with strong financing constraints and high environmental risk.

7.2. Policy Implications

First, enterprises should accelerate the digital transformation of ESG disclosure, build standardized and structured ESG digital disclosure systems, improve the transparency and authenticity of sustainable information disclosure, and take high-quality digital ESG disclosure as an important way to reduce financing costs.

Second, financial regulatory authorities should further improve the intelligent FinTech supervision system, strengthen the digital supervision of corporate ESG disclosure behaviors, standardize industry disclosure standards, and avoid false and selective disclosure of ESG information.

Third, differentiated supervision and guidance policies should be formulated. For non-state-owned enterprises and heavy-polluting industries, strengthen policy incentives for ESG digital disclosure and FinTech supervision empowerment, so as to effectively alleviate their financing constraints and promote the high-quality sustainable development of enterprises.

7.3. Research Limitations and Prospects

This paper only focuses on the overall moderating effect of FinTech supervision, and does not further subdivide the dimensional differences of FinTech supervision (such as policy supervision and technical supervision). Future research can subdivide FinTech supervision types and ESG digital disclosure dimensions to explore the differential influencing mechanism, so as to enrich the research system of digital sustainable governance and corporate financing.

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