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Research on the Impact of Digital Inclusive Finance on Corporate Financing Costs: Theoretical Mechanisms and Empirical Tests

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Abstract. This paper takes Shanghai and Shenzhen A-share non-financial listed companies from 2012 to 2023 as the sample, matches city-level digital inclusive finance indexes of firms' registered places with corporate financial data, and examines the relationship between regional digital finance development and corporate financing costs. The empirical part uses the natural logarithm of financing costs as the dependent variable and the prefecture-level city digital inclusive finance aggregate index as the core explanatory variable; after adding control variables such as firm size, leverage, profitability, growth and firm age, industry and year fixed effects are controlled, and standard errors are clustered at the firm level. The results show that the estimated coefficient of the digital inclusive finance index is −0.1757 and is significant at the 1% level, indicating that regions with higher digital finance development correspond to lower corporate financing costs. Further analysis finds that digital inclusive finance is significantly positively correlated with both analyst attention and research report coverage, which supports the explanatory channel of external information environment improvement. Grouping results show that this negative relationship is more obvious in the samples of non-state-owned enterprises, larger enterprises and the eastern region. After adopting an alternative financing cost indicator, adding province fixed effects and excluding several special years, the main conclusions remain stable. Overall, the development of regional digital inclusive finance has a stable association with the improvement of corporate financing conditions, and its effect may be related to the external information environment and firm and regional characteristics.

Keywords: digital inclusive finance, corporate financing cost, external information environment, ownership, firm size

1. Introduction

The cost a firm pays for using external funds directly affects investment expansion, R&D input and capital structure adjustment; therefore, financing costs are both an important manifestation of a firm's financing conditions and the result of creditors' risk pricing. Traditional credit decisions usually rely on financial statements, collateral assets, credit records and past business information. When the borrowing firm's information disclosure is insufficient, its operating conditions lack

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verifiability, or its credit risk is hard to judge accurately, financial institutions often need to invest more resources in investigation, review and post-loan monitoring, and hedge the uncertainty by raising risk compensation or increasing collateral requirements. As a result, the information environment a firm faces and its financial service conditions will affect the final price of funds it bears [1].

In recent years, big data, mobile internet, digital payment and intelligent risk control have been continuously embedded into financial business processes. The significance of digital inclusive finance lies not only in expanding the scope of service targets, but also in reshaping the way financial institutions obtain and process firm information. Firms' transaction flows, payment and settlement records and online business records can supplement traditional credit information, allowing financial institutions to observe operating states more timely, identify credit risks, and compress the costs of customer screening, credit assessment and business handling. Therefore, digital inclusive finance may not only improve financing availability, but may further affect the actual price a firm pays for debt funds [2-5].

Existing studies have discussed the micro-level effects of digital finance from the angles of financing constraints, credit access, firm innovation and operating performance, but by comparison, studies that directly use financing costs to measure changes in the price of funds and risk pricing are still worth deepening. Meanwhile, whether digital finance can affect financing pricing by improving firms' external information supply, and whether this relationship changes with different ownership nature, firm size or regional environment, also need to be further tested with firm-level data [6-8].

Accordingly, this paper matches Peking University's prefecture-level city digital inclusive finance index with the firm-year data of A-share non-financial listed companies from 2012 to 2023 at the city and year levels. The baseline regression uses the natural logarithm of corporate financing costs as the dependent variable and the city-level digital inclusive finance aggregate index as the core explanatory variable, controlling firm size, asset-liability ratio, return on assets, operating revenue growth and firm age, and including industry and year fixed effects, with standard errors clustered at the firm level. The mechanism part uses the number of tracking analysts and the number of research reports to describe firms' external information environment; the heterogeneity part compares estimation results across different ownership, firm size and regional samples.

In the baseline estimates, the coefficient of the digital inclusive finance index is −0.1757 and passes the 1% significance test, indicating that cities with higher digital finance development tend to correspond to lower corporate financing costs. The mechanism regressions further find that digital inclusive finance is significantly positively correlated with both analyst coverage and the number of research reports, suggesting that digital finance development may be accompanied by more sufficient external information production and dissemination. Grouping regressions show that this negative relationship is more prominent in non-state-owned enterprises, larger enterprises and the eastern region. After switching financing costs to other measures, adding province fixed effects and excluding special years, the core results still hold. Thereby, this paper supplements the empirical evidence on the firm-level effects of digital inclusive finance from three dimensions: financing price, external information environment and sample heterogeneity.

2. Theoretical analysis and research hypotheses

2.1. Digital inclusive finance and corporate financing costs

The digital inclusive finance discussed in this paper is a form of financial services formed by combining digital technology with inclusive finance business. Its role is not only to move traditional

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business online, but to reduce the costs of customer reach, information identification and transaction processing by means of big data, mobile internet, digital platforms and intelligent risk control. Compared with the traditional model relying on physical outlets, collateral materials and manual review, digital finance can expand the service radius, use multi-dimensional business data to improve the efficiency of credit identification, and reduce the resource input of customer acquisition, approval and post-loan management through standardized and automated processes. The empirical analysis uses the prefecture-level city digital inclusive finance aggregate index compiled by the Institute of Digital Finance at Peking University to measure the regional digital finance development level [1-5].

The financing costs actually borne by firms are affected by market interest rates and financing structure, and also depend on how financial institutions assess credit risk and information uncertainty. If a firm's operating conditions are difficult to fully observe and verify, creditors will usually demand additional risk compensation, and reduce potential losses through stricter review, collateral and monitoring arrangements. Traditional credit granting relies more on financial statements and collateral assets, while the payment, transaction and online business data accumulated by digital finance platforms can provide new judgment clues, allowing financial institutions to more fully identify firms' cash flow, operating stability and credit status. Meanwhile, online applications, automated review and digitalized post-loan management can also reduce business processing and monitoring costs. After the costs of information collection and risk judgment fall, the additional risk premium induced by information gaps may also narrow, creating conditions for financing costs to decline [2, 3, 7-10].

H1: The higher the regional digital inclusive finance development level, the lower the corporate financing costs.

2.2. The external information environment mechanism

The external information environment of firms reflects the convenience with which market participants obtain, process and understand firm information. The development of digital inclusive finance has increased the data sources available for observing firms' business activities, and reduced the technical costs of information sorting and dissemination. The continuous records left by payment and settlement, online transactions and other behaviors improve the observability of firms' operating states; the improvement of digital infrastructure and information processing capacity also allows professional information intermediaries such as analysts to collect, integrate and interpret firm information at lower cost. Generally, wider analyst coverage and more research reports mean that the firm obtains more sufficient professional information attention, and the scope of analysis and dissemination of public information is larger [5, 6].

When the external professional information supply is more sufficient, the difficulty for creditors to obtain and verify firm information will decline accordingly, and firms' operating performance, profitability and risk characteristics are easier to continuously compare and track. Thereby, financial institutions can assess default probability and solvency more finely, and the risk compensation corresponding to insufficient information may decrease. Based on this logic, this paper uses the number of tracking analysts and the number of research reports as proxy indicators of the external information environment, to examine whether digital inclusive finance is accompanied by improvement of firms' information environment [6, 9, 10].

H2: The higher the regional digital inclusive finance development level, the more sufficient the analyst tracking and research report coverage of firms, that is, the better the firms' external information environment.

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2.3. Heterogeneity analysis: region, ownership and firm size

Whether digital information can truly translate into financing pricing advantage is closely related to regional digital infrastructure, the technological capacity of financial institutions and data governance conditions. The eastern region's digital economy and fintech started earlier, and enterprises' digitalized operation and information disclosure foundations are relatively complete, so financial institutions can more easily incorporate digital data into credit assessment and credit pricing. Although the central-western and northeastern regions have room to use digital finance to make up for the supply of traditional finance, the deficiencies in data connection, technology application and financial institutions' digitalization capacity may limit further translation of digital information into price advantage. Based on this, this paper expects the cost-reducing relationship of digital inclusive finance to be more obvious in the eastern region [1, 6].

H3a: Compared with the central-western and northeastern regions, the negative impact of digital inclusive finance on corporate financing costs is more obvious in the eastern region.

Ownership nature affects firms' existing credit foundations, bank-firm ties and financing channels. State-owned enterprises usually have more stable bank relationships and stronger credit support, and the relevant information held by financial institutions is relatively sufficient, so the marginal effect of new digital information on financing pricing may be smaller. By contrast, non-state-owned enterprises rely more on market-based credit identification and external information transmission; digital inclusive finance, by increasing business data sources, improving risk identification efficiency and reducing information processing costs, may bring more obvious financing price improvement [9, 10].

H3b: Compared with state-owned enterprises, the negative impact of digital inclusive finance on corporate financing costs is more obvious in non-state-owned enterprises.

Firm size also affects the efficiency with which digital information is identified by financial institutions and used for pricing. Larger listed companies often have more standardized financial records, more continuous operating data and higher market attention, and this information is easier to be absorbed by digital risk control and credit assessment systems. Smaller firms may have stronger demand for financing improvement, but their operating data continuity, standardization level and external information coverage are relatively limited, so digital finance infrastructure may not translate into financing cost reduction to the same degree [9].

H3c: Compared with smaller firms, the negative impact of digital inclusive finance on corporate financing costs is more obvious in larger firms.

3. Research design

3.1. Data sources and sample construction

The empirical sample of this paper is A-share non-financial listed companies from 2012 to 2023. The city-level digital inclusive finance indicators are taken from the prefecture-level city digital inclusive finance index released by the Institute of Digital Finance, Peking University; corporate financial data, ownership nature, analyst coverage and research reports come from the CSMAR database. According to the firms' registered places and corresponding years, the firm-year data are matched with the digital inclusive finance index of the cities where they are located, finally forming a firm-year panel dataset [1].

In the sample sorting process, financial industry companies and ST and *ST firms are first removed, and observations with missing core variables or asset-liability ratio greater than 1 are

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deleted. To reduce the influence of extreme values on the estimation results, continuous variables are winsorized at both tails at the 1% and 99% percentiles. After data matching and screening, the baseline regression sample contains 25,611 firm-year observations. Since the listing years and variable availability periods of different firms are not completely consistent, this paper finally uses an unbalanced panel.

3.2. Variable definitions

1. Dependent variable. This paper uses corporate financing costs as the dependent variable. The baseline indicator FinCost is obtained by dividing financial expenses by average total assets, where average total assets is the mean of total assets at the beginning and end of the period, and its natural logarithm ln_FinCost is used in the regressions. The robustness tests also construct FinCost_liab as the ratio of financial expenses to average liabilities, also log-transformed. The two indicators measure the firm's financial expense burden based on asset size and liability size respectively.

2. Core explanatory variable. The regional digital inclusive finance development degree is measured by the digital inclusive finance aggregate index of the city where the firm is registered. To make the magnitude of the coefficient easier to interpret, the prefecture-level city aggregate index is divided by 100 in the regressions and recorded as DIF_city_index_100. The higher this indicator, the higher the digital inclusive finance development degree of the city where the firm is located.

3. Mechanism variables. The firms' external information environment is measured by the number of tracking analysts and the number of research reports respectively, and both indicators are natural-log transformed to obtain ln_Analyst and ln_Report. Analysts and research reports undertake the functions of collecting, processing and disseminating firm information, so wider analyst and report coverage usually means more sufficient external professional information supply. Note that these two indicators reflect the firms' external information environment, not a direct measurement of the degree of information asymmetry [6].

4. Control variables and grouping variables. The baseline model adds control variables such as firm size (Size), asset-liability ratio (Lev), profitability (ROA), growth (Growth) and firm age (Age). Among them, Size is the natural logarithm of total assets, Lev equals total liabilities divided by total assets, ROA measures the return on assets, Growth uses the operating revenue growth rate, and Age is the natural logarithm of the firm's years since establishment. The ownership grouping distinguishes state-owned and non-state-owned enterprises according to the nature of the firm's actual controller; the regional grouping classifies Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan as the eastern region, and the remaining provinces as the central-western and northeastern regions; the size grouping divides firms into a smaller-size group and a larger-size group by the annual median of firm size.

3.3. Model specification

To examine the relationship between city digital inclusive finance development and corporate financing costs, this paper sets the following baseline regression model:

$$\mathrm{lnFinCost_it} = \alpha + \beta\,\mathrm{DIF_ct} + \gamma'\mathrm{X_it} + \eta_j + \lambda_t + \varepsilon_it \tag{1}$$

where i, t, c and j denote firm, year, city and industry respectively; lnFinCost_it is the natural logarithm of corporate financing costs; DIF_ct is the digital inclusive finance index of the city where the firm is located in the current year; X_it is the set of firm-level control variables; η_j and λ_t

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denote industry fixed effects and year fixed effects respectively; and ε_it is the random error term. Standard errors are clustered at the firm level. This paper focuses on the coefficient β; if β is significantly negative, it indicates that the higher the digital inclusive finance development level, the lower the corporate financing costs.

Beyond the baseline regression, this paper further uses the following equation to test whether digital inclusive finance is associated with improvement of firms' external information environment:

$$\text{Info_it} = \alpha + \theta\,\text{DIF_ct} + \gamma'\text{X_it} + \eta_j + \lambda_t + \varepsilon_{it} \tag{2}$$

where Info_it takes ln_Analyst and ln_Report in turn, and the other control variables and fixed effect settings are the same as the baseline model. When θ is significantly positive, it means that regions with higher digital inclusive finance levels usually correspond to more analyst attention and research report coverage, thus supporting the external information environment channel. What needs to be stressed is that this specification cannot directly identify the complete causal mediation effect, so this paper treats it only as mechanism consistency evidence.

The heterogeneity analysis re-estimates the baseline model in the ownership, firm size and regional subsamples respectively. Since significance differences across subsamples are not equivalent to statistically significant between-group coefficient differences, this paper mainly compares the sign, magnitude and within-group significance of the coefficients of each group, and treats the relevant results as directional heterogeneity evidence.

3.4. Robustness test design

The robustness tests proceed in four aspects. First, switch to the ratio of financial expenses to average liabilities with natural logarithm, to examine whether the results depend on the specific measure of financing costs; second, further control province fixed effects in addition to industry and year fixed effects; third, delete the 2020—2021 observations, to reduce the influence of the special operating environment and financing conditions during the pandemic on the estimates; fourth, exclude the 2018 and 2019 samples respectively, to test whether stage institutional changes such as the new asset management regulations, financial deleveraging, private enterprise financing relief and the loan market quoted interest rate reform affect the baseline results.

4. Empirical results and analysis

4.1. Sample overview and correlations

The baseline regression finally contains 25,611 firm-year observations, and the main variables have fairly sufficient variation in both the firm and year dimensions. The uncontrolled correlations show that the city digital inclusive finance index is negatively correlated with corporate financing costs, and positively correlated with analyst coverage and the number of research reports, consistent with the theoretical expectations. However, simple correlations may be simultaneously affected by firm characteristics and common year shocks, so the following uses multiple regressions for further testing.

4.2. Baseline regression results

Table 1 presents the baseline estimates of digital inclusive finance and corporate financing costs. The model adds control variables such as firm size, asset-liability ratio, profitability, growth and

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firm age, controls industry and year fixed effects, and computes clustered standard errors at the firm level.

Table 1. Baseline regression of digital inclusive finance and corporate financing costs

Variable	ln_FinCost
DIF (city-level index/100)	−0.1757***
	(0.0505)
Size	−0.0304***
	(0.0116)
Lev	3.1071***
	(0.0648)
ROA	−0.9069***
	(0.1193)
Growth	0.0033
	(0.0148)
Age	0.0155
	(0.0150)
Industry FE	Yes
Year FE	Yes
Observations	25,611
Adjusted R^2	0.3242

Note: Standard errors clustered at the firm level are in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. The same below.

In Table 1, the estimated coefficient of DIF is −0.1757 and significant at the 1% level. Since DIF_city_index_100 is the original city-level index divided by 100, after controlling firm characteristics and common industry and year factors, cities with higher digital inclusive finance development correspond to lower corporate financing costs, consistent with the expectation of H1. As for control variables, the coefficients of Size and ROA are significantly negative, Lev is significantly positive, while Growth and Age are not significant at conventional levels.

4.3. Mechanism tests: the external information environment channel

Table 2 uses the natural logarithms of the number of tracking analysts and the number of research reports as dependent variables respectively, to test the relationship between city digital inclusive finance development and firms' external professional information supply.

Table 2. Digital inclusive finance and firms' external information environment

Variable	ln_Analyst	ln_Report
DIF (city-level index/100)	0.1645***	0.2220***
	(0.0534)	(0.0665)
Size	0.3839***	0.4783***
	(0.0114)	(0.0143)

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Table 2. (continued)

Lev	−0.5094***	−0.5817***
	(0.0674)	(0.0843)
ROA	3.6029***	4.8280***
	(0.1878)	(0.2434)
Growth	0.0410***	0.0844***
	(0.0146)	(0.0192)
Age	−0.1840***	−0.2213***
	(0.0155)	(0.0195)
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	16,493	16,514
Adjusted R^2	0.2999	0.3004

Note: Standard errors clustered at the firm level are in parentheses.

The estimated coefficients of DIF on ln_Analyst and ln_Report are 0.1645 and 0.2220 respectively, both significantly positive at the 1% level. This means that in regions with higher digital inclusive finance development, firms tend to obtain more analyst attention and research report coverage, and the production and dissemination of external professional information is more sufficient. This result is consistent with H2 and supports the explanatory channel of the external information environment. Note that analyst coverage and the number of reports are only proxy variables of the external information environment, and the current regressions do not directly identify the complete mediation process, so they cannot be understood as strict causal mediation effects.

4.4. Heterogeneity analysis

Table 3 conducts grouped estimates by firm ownership, size and region respectively, and each subsample uses the same control variables, industry fixed effects and year fixed effects as the baseline regression.

Table 3. Heterogeneity of ownership, firm size and region

Variable	State-owned	Non-state-owned	Smaller size	Larger size	Eastern	Central-western and Northeast
DIF (city-level index/100)	−0.1180	−0.2031***	−0.1202*	−0.2066***	−0.2945***	−0.2023**
	(0.0886)	(0.0608)	(0.0686)	(0.0660)	(0.0771)	(0.0939)
Size	−0.0537***	0.0054	0.1411***	−0.1077***	−0.0618***	0.0214
	(0.0183)	(0.0152)	(0.0251)	(0.0179)	(0.0145)	(0.0191)
Lev	3.0704***	3.1822***	3.3429***	2.7833***	3.2331***	2.9859***
	(0.1205)	(0.0773)	(0.0791)	(0.1010)	(0.0864)	(0.0990)
ROA	−1.3680***	−0.7204***	−0.5793***	−2.0415***	−0.8141***	−0.9874***

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Table 3. (continued)

	(0.2834)	(0.1311)	(0.1354)	(0.2261)	(0.1470)	(0.2077)
Growth	0.0696***	−0.0433**	−0.0597***	0.0710***	−0.0066	0.0209
	(0.0214)	(0.0191)	(0.0210)	(0.0199)	(0.0202)	(0.0216)
Age	0.0332	0.0552***	0.0131	0.0082	0.0461**	−0.0211
	(0.0307)	(0.0186)	(0.0184)	(0.0225)	(0.0186)	(0.0260)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,270	16,340	12,674	12,935	16,978	8,632
Adjusted R^2	0.3680	0.3142	0.3179	0.3399	0.3063	0.3615

Note: This table compares the direction, magnitude and statistical significance of coefficients across firm types through subsample regressions. Since no formal between-group coefficient difference test is implemented, one cannot judge that the two groups' coefficients differ statistically merely because one group is significant and the other is not.

In the ownership grouping, the DIF coefficient of the state-owned enterprise sample is −0.1180, not reaching conventional significance standards; the coefficient of the non-state-owned enterprise sample is −0.2031 and significant at the 1% level. In terms of point estimates and within-group statistical evidence, the negative relationship between digital inclusive finance and financing costs is more prominent in non-state-owned enterprises, consistent with the directional expectation of H3b.

The size grouping results show that the DIF coefficient of smaller firms is −0.1202, significant at the 10% level; the coefficient of larger firms is −0.2066 and significant at the 1% level. The latter's coefficient has a larger absolute value and stronger within-group statistical evidence, consistent with the direction expected by H3c.

In the regional grouping, the DIF coefficient of the eastern sample is −0.2945 and significant at the 1% level; the coefficient of the central-western and northeastern regions is −0.2023, significant at the 5% level. Both groups show significant negative relationships, but the point estimate of the eastern region has a higher absolute value, consistent with the directional judgment of H3a. Overall, the relationship between digital inclusive finance and financing costs shows certain differences across regional samples, but whether there is a strict between-group coefficient difference still needs further tests using interaction terms or formal coefficient comparison.

4.5. Robustness tests

Table 4 summarizes five robustness tests, including switching the financing cost indicator, adding province fixed effects, excluding 2020—2021, excluding 2018 and excluding 2019 samples in turn.

Table 4. Robustness test results

Variable	Alternative DV	Province FE added	Excl. 2020—2021	Excl. 2018	Excl. 2019
DIF (city-level index/100)	−0.1787***	−0.2523***	−0.1955***	−0.1815***	−0.1687***
	(0.0492)	(0.0669)	(0.0546)	(0.0502)	(0.0506)

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Table 4. (continued)

Size	−0.0328***	−0.0293**	−0.0264**	−0.0336***	−0.0316***
	(0.0114)	(0.0120)	(0.0123)	(0.0116)	(0.0117)
Lev	0.9620***	3.1102***	3.1302***	3.0721***	3.0669***
	(0.0626)	(0.0655)	(0.0687)	(0.0645)	(0.0657)
ROA	−1.4329***	−0.8946***	−0.9495***	−0.9668***	−0.9316***
	(0.1147)	(0.1187)	(0.1355)	(0.1286)	(0.1279)
Growth	0.0218	0.0031	−0.0027	0.0053	0.0078
	(0.0143)	(0.0148)	(0.0163)	(0.0154)	(0.0156)
Age	−0.0103	0.0171	0.0247	0.0145	0.0143
	(0.0147)	(0.0151)	(0.0160)	(0.0151)	(0.0150)
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Province FE	No	Yes	No	No	No
Observations	25,611	25,611	20,136	23,370	23,221
Adjusted R^2	0.1469	0.3266	0.3328	0.3215	0.3220

Note: The dependent variable of column (1) is ln_FinCost_liab, and that of the other columns is ln_FinCost.

Under the alternative financing cost indicator, the estimated coefficient of DIF is −0.1787 and significant at the 1% level; after adding province fixed effects, the core coefficient is −0.2523, also significantly negative. After further deleting the 2020—2021, 2018 and 2019 observations, the coefficients of DIF are −0.1955, −0.1815 and −0.1687 in turn, all passing the 1% significance test. Under different settings, the sign and statistical significance of the core variable are consistent with the baseline estimates, indicating that the results do not depend on a single financing cost definition, a single fixed effect setting or a few special years.

The above tests mainly show that the core estimates have strong stability under different variable measures and sample settings, but all potential sources of endogeneity cannot be excluded accordingly. For example, city-level factors that change over time and are not controlled by the model may still simultaneously affect digital inclusive finance development and corporate financing conditions. Therefore, this paper interprets the baseline results as fairly stable empirical associations, without making causal inferences beyond the current identification design.

5. Conclusions and policy implications

5.1. Main conclusions

This paper uses panel data of A-share non-financial listed companies from 2012 to 2023, matches the prefecture-level city digital inclusive finance index with corporate financial information, examines the relationship between regional digital finance development and corporate financing

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costs, and further conducts extended analysis from external information environment, ownership, firm size and regional differences. Based on the empirical results above, the main findings are as follows.

First, the development degree of digital inclusive finance is significantly correlated with lower corporate financing costs. In the baseline regression, the estimated coefficient of DIF_city_index_100 is −0.1757 and significant at the 1% level. Whether switching the financing cost definition, adding province fixed effects, or excluding several special years, the core estimates remain negative and significant.

Second, digital inclusive finance is significantly correlated with more sufficient external professional information supply of firms. The estimates of DIF on the number of tracking analysts and the number of research reports are both significantly positive, indicating that digital finance development may improve the conditions for the production and dissemination of firm information, providing more information basis for creditors' risk identification and financing pricing. Since the current tests do not fully identify the mediation path, this result is mainly regarded as empirical evidence supporting the external information environment channel.

Third, the grouped regressions show that the negative relationship between digital inclusive finance and financing costs differs across firm and regional samples. The absolute values of the DIF coefficients of non-state-owned enterprises, larger enterprises and the eastern region are larger, and the within-group statistical evidence is relatively stronger, with the overall direction consistent with theoretical expectations. But since the paper has not implemented formal between-group coefficient comparison, the relevant conclusions are more suitable as directional descriptions of heterogeneity.

5.2. Policy implications

At the policy level, the standardization, verifiability and compliant utilization of firms' business data should first be improved, and the corresponding data governance system should be perfected, so that payment, transaction and other multi-source business information can more effectively serve credit assessment and risk pricing. The value of digital inclusive finance lies not only in expanding financial service coverage, but also in reducing the costs of information collection, verification and processing. Therefore, promoting information sharing, unified data standards and digital credit reporting under the premise of data security and legal authorization will help financial institutions form more complete corporate credit judgments and reduce dependence on single collateral information.

Second, attention should be paid to the differences among regions in digital finance infrastructure conditions. The higher absolute value of the point estimate in the eastern region may indicate that the degree of matching between digital infrastructure, fintech capacity and enterprise data foundations affects whether digital finance advantages can translate into financing price improvement. For the central-western and northeastern regions, the policy focus should not only be expanding digital finance coverage, but also simultaneously improving financial institutions' data processing, credit modeling and digitalized service capacity, so that new digital information can truly enter credit decisions and risk pricing processes.

Finally, the matching degree between digital financial services and market-based financing entities such as non-state-owned enterprises should be further improved. The grouping results show that the negative coefficient is more prominent in non-state-owned enterprises. On the premise of prudent operation and compliant risk control, financial institutions can more fully use the multi-dimensional information formed by transactions, payments and business activities, improve

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digitalized credit evaluation and credit granting processes, reduce the additional risk compensation formed by insufficient information, and thus improve corporate financing conditions.

5.3. Limitations and future prospects

There is still room for further improvement in this paper. First, the financing cost indicator is constructed from listed companies' financial statements and may be affected by accounting treatment and differences in corporate financing structure; meanwhile, listed companies differ obviously from the large number of unlisted small and medium-sized enterprises in scale, governance and financing channels, so the external applicability of the conclusions still needs further testing. Second, analyst tracking and the number of research reports only indirectly reflect the firms' external information environment, cannot directly measure the information gap between banks and firms, and are not sufficient to separately identify the complete transmission mechanism. Follow-up research can, on the one hand, combine stronger identification designs or exogenous institutional shocks to improve the causal identification of digital inclusive finance's financing cost effect; on the other hand, introduce firm-bank credit relationships, actual loan interest rates, credit lines and more direct information friction indicators to further test the information environment and risk pricing channels.

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