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Can Digital Inclusive Finance Improve the Financial Performance of SMEs?

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Abstract: Our paper takes the sample of listed companies from Shanghai and Shenzhen A-share SMEs and then theoretically analyzes and empirically tests the impact of digital inclusive finance on the financial performance of SMEs. The results show that financial performance of SMEs located in areas with a higher level of digital inclusive finance is significantly higher. Digital inclusive finance can play a role in expanding the scale of innovative investment, reducing the cost of debt financing and improving the ability of risk-taking, thereby strengthening the financial performance of SMEs. Our findings enrich the academic research on the topic of digital inclusive finance from the perspective of SMEs and provide suggestions to the government, banks and SMEs to continually implement the digital inclusive finance policy.

Keywords: digital inclusive finance; financing performance; innovative investment scale; debt-financing cost; risk-taking ability

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1. Introduction

Corporate financial performance is an important issue in academic research. The prior literature has examined the factors that mitigate corporate financial performance, including ownership governance [1,2], internal control systems [3–5] and board characteristics [6,7]. Evidence also emphasizes political connections [8–10] and market competition [11–13] as external factors that influence corporate financial performance. These findings underscore the roles of internal and external factors in corporate financial performance. Furthermore, scholars argue that monetary policies [14–16] and institutional design [17] can play fundamental roles in improving corporate financial performance. These studies suggest that external policies affect the internal corporate decisions that affect financial performance ultimately.

Small- and medium-sized enterprises (SMEs) are a new driving force of the economic development in China and are vital in stabilizing economic growth, adjusting the industry structure, improving people's livelihood and preventing operating risks. However, when subjected to operating risks [18] and financing credit problems [19], SMEs find it difficult to obtain stable financial support from banks, which ultimately causes their failure in fierce market competition [20,21]. To solve the problems of "difficult financing" and "expensive financing" in SMEs, the inclusive finance policy is implemented to alleviate the financial constraints and information asymmetry of SMEs. However, the implementation effect of inclusive finance cannot achieve the goal for the constraints of traditional financial technology that is unfriendly to support the sustainable development of SMEs. The development of information technology safeguards the implementation effect of inclusive finance, optimizes resource allocation and eliminates the information gap [22,23] by combining it with digital technology [24] to guide banks to provide credit support to SMEs. Thus, inclusive finance digitization influences the behavior of SMEs through banks' credit policy and ultimately affects the financial performance of SMEs.

Prior studies reveal that digital inclusive finance (DIF) has an impact on economic growth in China by increasing personal income [25], household resource allocation

efficiency [26], energy consumption [27], the urban-rural income gap [28] and the family debt gap [29]. Our paper extends the literature on the role of DIF in the internal decisions and financial performance of SMEs from the perspective of entrepreneurship. Following Guo et al. (2020) [30], we choose the Peking University digital inclusive finance index as the proxy for DIF and test the relationship between DIF and the financial performance of SMEs. Our data are from the main stock exchanges (Shanghai and Shenzhen Stock Exchange) in China from 2016 to 2020. Results show that the financial performance of SMEs is positively associated with the impact from DIF and are robust after dealing with potential endogeneity issues and variable measurement bias. Further analysis also shows that the role of DIF in the financial performance of SMEs includes increasing the scale of innovative investment, reducing the cost of debt financing and strengthening the ability of risk taking.

We attempt to contribute to the literature in the following ways. First, we contribute to the stream of the literature that documents the impact of DIF on the financial performance of SMEs. Specifically, we employ a firm-level analysis of the role of DIF in effecting firms' activities and extend prior studies from the perspective of entrepreneurship [31]. Second, our contribution lies on the mechanism of DIF to empower the financial performance of SMEs. The prior literature mainly focuses on the perspective of financing constraints [32] by examining the mechanism of DIF to economic development, and our findings supplement the prior literature by providing insights into the function of digital technology to optimize resource allocation [24] and bridge the information gap [22,23]. Third, our findings also have practical implications for the government, banks and SMEs via the compatible use of DIF policy to optimize scientific decision-making, thus improving the financial performance of SMEs.

The rest of this paper is arranged as follows: theoretical analysis and hypothesis development is presented in Section 2. Research design and method are included in Section 3. Empirical results and discussion are shown in Section 4, followed by a conclusion in the end.

2. Theoretical Analysis and Hypothesis Development

2.1. Digital Inclusive Finance

The digital technology revolution provides an opportunity for the effective implementation of DIF in the Chinese market [33]. With the rapid development of information technology, emerging digital intelligence technologies such as the internet, cloud computing, big data, blockchain and artificial intelligence have been gradually applied to the financial field, which creates a new ecology of "boundless finance" and expands the boundaries of financial services. Compared with traditional inclusive finance, DIF has two distinct characteristics. First, digital technology and financial systems are deeply integrated. Internet technology realizes "everything counts", which can provide financial institutions with massive data support. Cloud computing builds a financial cloud with a distributed architecture that can realize data storage and function sharing. Big data, which depends on its efficient and professional data-mining ability, can realize the financial enabling transaction function of data. Blockchain is a distributed, shared ledger that can improve the security of financial activities with its characteristics of "non-tamperability" and "decentralization". Artificial intelligence technology takes intelligent equipment as the carrier that can break through the excessive dependence of traditional finance on personnel and ensure the all-weather, automatic processing of financial services. The interaction of five kinds of technologies has a subversive impact on inclusive finance in terms of data sources of credit information expansion, potential customer needs exploration and the improvement on the efficiency of risk pricing. The other part, the target objects, can be combined with precise financial products. Inclusive financial policy can identify the target of financial policy by supporting digital technology and play the role of helping financially vulnerable groups by providing targeted financial policies. In addition, digital technology can improve the collection efficiency of nongovernmental idle funds and strengthen the function of idle funds to support the activities of target enterprises.

The advancement of digital technology has stimulated the development of DIF. Specifically, the application of digital technology to inclusive finance makes DIF present the following three characteristics. First, DIF can strengthen the information acquisition ability of the banks and effectively promote credit technology innovation. By integrating credit information and judicial information data, DIF can quickly collect and analyze the real status of credit objects and then strengthen the bank's ability to identify potential assistance objects. Second, DIF can improve the asset pricing ability of banks. DIF depends on its digital technologies to effectively identify the expected returns and potential risks of financial credit and then strengthen the pricing ability of financial assets. Third, DIF can optimize the allocation efficiency of banks' financial assets. Inclusive finance relies on digital technology to enhance the overall planning ability of idle funds and the efficiency of bank loans to optimize the allocation efficiency of financial resources.

2.2. DIF and Financial Performance of SMEs

Debt financing is an important way for SMEs to obtain financial resources. Inclusive finance relies on digital technology to strengthen the information acquisition ability, asset pricing ability and resource allocation efficiency of banks, which may further affect the financial decision-making effectiveness of SMEs and ultimately improve the financial performance of SMEs. Specifically, the impact of DIF on the financial performance of SMEs may include the following.

First, DIF can enhance the scale of innovative investment for SMEs, thus optimizing their financial performance. Compared with traditional inclusive financial policy, DIF relies on emerging digital technologies such as the internet, big data, cloud computing, artificial intelligence and blockchain, which can effectively identify the real situation of the objects supported and guide the allocation of idle funds to SMEs in need of financial support. Innovation is a kind of investment activity with high risks and uncertain returns that banks need to obtain sufficient information to make credit decisions. Under the traditional inclusive financial system, banks always abandon the credit plan for SMEs to avoid risk, but digital technology can improve the ability of banks to obtain information on SMEs and strengthen their judgment of the value of the innovative activities of SMEs. This is obviously helpful to increase the willingness of banks to provide credit for supporting the innovative activities of SMEs, thereby empowering the financial performance of SMEs.

Second, DIF can reduce the cost of debt financing for SMEs, thus optimizing their financial performance. Compared with traditional inclusive financial policy, DIF can reduce banks' dependence on high-cost facilities and equipment such as offline outlets and staff. This alleviates the cost of debt financing by reducing banks' operating expenses and credit costs. Moreover, DIF can help banks to improve the accuracy of the information obtained, which reduces the risk compensation cost of bank financial loans. In addition, DIF can rely on mobile platforms such as the internet to absorb idle funds from the society and increase the amount of credit provided to reduce the cost of debt financing for SMEs, which ultimately improves the financial performance of SMEs.

Third, DIF can strengthen the risk-taking ability of SMEs, thus optimizing their financial performance. DIF can improve the probability of SMEs obtaining debt financing and ensure that SMEs can obtain diversified and abundant cash assets to cope with risks in business activities, which will obviously strengthen the risk-taking ability of SMEs and improve their financial performance. In addition, DIF can help SMEs improve their risk-taking ability by integrating the internal and external information of the industry and transmitting market and ultimately improve their operational performance.

Based on the above analysis, we propose our hypothesis as follows:

H1. *DIF can improve the financial performance of SMEs.*

3. Research Design and Method

3.1. Research Model and Key Variables

We construct the following model to test our main hypothesis:

$$Performance_{it} = \beta_0 + \beta_1 Digfincity_{it} + \Sigma Controls_{it} + \beta_2 Year + \beta_3 Industry + \varepsilon_{it} \quad (1)$$

Performance represents the financial performance of SMEs, which is measured by *ROA* and *TobinQ*. *ROA* is the ratio of profit before interest and tax to total assets, and this indicator can reflect the profitability of the business activities of SMEs. *TobinQ* is the ratio of the total market value of equity and debt to total assets, which reflects the sales growth ability of the business activities of SMEs. *Digfincity* means DIF which is the independent variable and is measured by the "Peking University digital inclusive finance index" which is compiled and maintained by the digital finance research center of Peking University. A larger value of *digfincity* indicates that the firms are influenced by a higher degree of DIF. Control variables include: *Firmsize*, *Salesgrowth*, *Leverage*, *Cashholding*, *SOE*, *Firmage*, *Boardsize* and *TOP1*. Furthermore, we control for year and industry fixed effects. The full definition of all variables can be accessed from the Appendix A. From our hypothesis, we expect β_1 to be significantly positive.

3.2. Sample Selection

The sample in this paper is from Chinese listed firms whose first three digits of code start with "002" or "300" in the Shanghai and Shenzhen Stock Exchange markets from 2016 to 2020. We examine the relationship between DIF and the financial performance of SMEs within the available data area. We screen our data with the following deletion: (1) observations from the industries of finance and insurance, (2) observations labelled as "delisted" or "special treatment" (*ST*) firms, (3) observations with negative net assets and (4) firms without sufficient data for regression. Finally, we obtain 4133 firm-year observations from 883 listed SMEs. The financial data for this paper are obtained from the Wind database and the China Stock Market and Accounting Research (*CSMAR*) database.

4. Empirical Results and discussion

4.1. Descriptive Statistics

The descriptive statistics for the main variables are presented in Table 1. All continuous variables are winsorized at 1% and 99% level to avoid the outliers and extreme values. Based on the statistics, the mean values of *ROA* and *TobinQ* are 0.041 and 1.929, with standard deviations to be 0.051 and 0.909, respectively. The medium values of the two are 0.051 and 0.909. This suggests that the profitability and sales growth ability widely differ among the samples, and there is a significant variation. The mean of *digfincity* is 284.024, with minimum and maximum values being 190.568 and 402.500, respectively. This shows that the degree of DIF among different prefecture-level cities is obviously different, which conforms to the basic situation of regional financial development in China. Table 1 also shows the distribution and spread of other variables, which is consistent with prior studies.

4.2. Univariate Test

In this section, we conduct a univariate analysis as preliminary testing to capture a preview of the relationship between DIF and the financial performance of SMEs. The univariate analysis is conducted with two groups divided according to the mean value of the digital inclusive financial index of prefecture-level cities of the year. The group below the mean value is labeled as "*Lower Digfincity*", which shows that firms are influenced by a lower degree of DIF. The group above the mean value is then labeled as "*Higher Digfincity*", which shows that firms are having a higher degree of DIF. We then test the difference between the two groups by calculating the average values and the mediate values of *ROA* and *TobinQ*. The result reported in Table 2 is consistent with our hypothesis that DIF can play a role in improving the financial performance of SMEs.

Table 1. Descriptive statistics.

Variable	Mean	S.D.	Min	Median	Max	N
ROA	0.041	0.051	−0.073	0.039	0.141	4133
TobinQ	1.929	0.909	0.976	1.645	4.745	4133
Digfincity	284.024	32.292	190.568	291.454	402.500	4133
Firmsize	22.140	0.965	20.305	22.112	24.596	4133
Salesgrowth	0.247	0.437	−0.335	0.138	1.876	4133
Leverage	0.400	0.194	0.014	0.389	3.919	4133
Cashholding	0.180	0.119	0.007	0.149	0.783	4133
SOE	0.744	0.437	0.000	1.000	1.000	4133
Firmage	2.020	0.614	0.000	2.197	3.332	4133
Boardsize	2.103	0.159	1.792	2.197	2.398	4133
TOP1	31.787	13.844	2.870	29.810	81.850	4133

Table 2. Univariate analysis.

Variable	Mean of the Group		t Statistic	z Statistic
	(1) Lower Digfincity	(2) Higher Digfincity	(2)–(1)	(2)–(1)
ROA	0.040	0.049	3.015 ***	2.747 ***
TobinQ	1.888	2.429	10.264 ***	11.935 ***

Note: The tests of the difference in mean are reported using the *t* test and *z* test. The two groups of lower and higher digfincity are set according to the mean of the total digfincity index, which is obtained from the "Peking University digital inclusive finance index". Lower digfincity means that firms are influenced by a lower degree of digital inclusiveness, and higher digfincity means that firms are influenced by a higher degree of digital inclusiveness. *** indicate significance levels of 1%.

4.3. Regression Results

The multivariate regression result is reported in Table 3. Consistent with our prediction in the hypothesis, there is a positive relationship between DIF and the financial performance of SMEs. Column 1 shows the result of using *ROA* as the proxy for financial performance, and Column 2 represents the result using *TobinQ* as the proxy. In all results, we use robust standard errors for firm clustering and report t values on an adjusted basis. In this way, we try to alleviate the concern of potential cross-sectional and time series dependence in the data.

Table 3 shows that both coefficients of *digfincity* in Column (1) and (2) are positively significant at the 5% level, which is in line with our prediction that there is a positive relationship between DIF and the financial performance of SMEs. Our findings suggest that higher financial performance of SMEs is associated with higher influence of DIF. In other words, SMEs influenced by DIF policy will improve their financial performance. DIF can expand the scale of innovative investment, reduce the cost of debt financing and improve the risk-taking ability of SMEs by relying on digital technology to realize the continuous improvement of the financial performance of SMEs. The above results show the importance of inclusive finance and broaden our understanding of its impact on stimulating the financial performance of SMEs.

Table 3. Regression result of the main hypothesis.

Variable	ROA	TobinQ
	(1)	(2)
Digfincity	**0.000 ****	**0.002 ****
	(1.982)	**(2.292)**
Firmsize	0.018 ***	−0.284 ***
	(11.142)	(−7.355)
Salesgrowth	−0.001	−0.039
	(−0.521)	(−1.042)
Leverage	−0.106 ***	−0.598 ***
	(−9.772)	(−2.834)
Cashholding	0.061 ***	0.387 **
	(5.725)	(2.161)
SOE	−0.000	−0.141 ***
	(−0.110)	(−2.560)
Firmage	−0.021 ***	0.261 ***
	(−10.788)	(6.233)
Boardsize	0.015 **	−0.283 **
	(2.238)	(−2.056)
TOP1	0.000 ***	0.004 **
	(4.502)	(2.094)
Constant	−0.341 ***	8.309 ***
	(−9.165)	(9.469)
Industry	YES	YES
Year	YES	YES
Adjusted-R^2	0.278	0.275
N	4133	4133

Note: Key variables are shown in bold text. *ROA* and *TobinQ* are the dependent variables. The independent variable is Digfincity, which is chosen from the "Peking University digital inclusive finance index". The complete definition of the control variables can be found in Appendix A. Cluster-adjusted robust standard errors are in parenthesis. *** and ** indicate significance levels of 1% and 5%.

4.4. Robustness Tests

The econometric literature suggests that the endogeneity issues cannot be addressed by any single statistical methodology. Thus, a combination of different methods is recommended [34]. Following the literature, we use multiple different but complementary techniques to further control for the endogeneity issues, including measurement error, simultaneity and omitted variables. In our robustness tests, we use different units of measurement for the independent variable to control for measurement error, further controlling the impact of macro influenced factors to deal with simultaneity issues and apply instrumental variable (IV) two-stage least square regressions to control for omitted variables.

4.4.1. Robustness Test with Reconstructed Key Variables

In this section, we test our hypothesis using different units of DIF to further the robustness of our findings. We use different geographical county levels and create a new independent variable labeled *digfincounty.* The data of *digfincounty* are obtained from the digital finance research center of Peking University during 2016–2020. Following Nakatani (2019) [35], we also replace the measurement method of the dependent variable by ROE and profit margin

(*Profit-M*) and use Model 1 to robustly test the relationship between DIF and the financial performance of SMEs. Results in Column 3 and Column 4 of Table 4 suggest that our results are consistent and robust even when alternative measures of the independent variable (*digfincounty)* and the dependent variable (ROE and *Profit-M*) are used.

Table 4. Robustness test with key variables reconstructed and controlling for the impact of macro influenced factors.

Variable	*ROA*	*TobinQ*	*ROE*	*Profit-M*	*ROA*	*TobinQ*
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Digfincounty	**0.000 ***	**0.007 *****				
	(1.953)	**(2.884)**				
Digfincity			**0.000 ****	**0.003 *****		
			(2.334)	**(3.417)**		
Digfincity_R					**0.000 *****	**0.001 ***
					(2.665)	**(1.664)**
Firmsize	0.020 ***	−0.269 ***	0.017 ***	−0.226 ***	0.018 ***	−0.284 ***
	(11.206)	(−6.692)	(8.923)	(−13.983)	(20.284)	(−18.246)
Salesgrowth	−0.000	−0.047	0.000	−0.332	−0.001	−0.037
	(−0.138)	(−1.176)	(0.874)	(−1.074)	(−0.650)	(−1.292)
Leverage	−0.116 ***	−0.588 ***	−0.145 ***	−0.521 **	−0.106 ***	−0.595 ***
	(−9.404)	(−2.686)	(−7.427)	(−1.972)	(−25.222)	(−7.957)
Cashholding	0.067 ***	0.434 **	0.053 ***	0.387 ***	0.062 ***	0.401 ***
	(5.694)	(2.375)	(3.677)	(2.786)	(9.872)	(3.597)
SOE	−0.001	−0.153 ***	−0.001	−0.169 ***	−0.000	−0.140 ***
	(−0.229)	(−2.695)	(−1.443)	(−7.762)	(−0.147)	(−4.834)
Firmage	−0.023 ***	0.224 ***	−0.031 ***	0.199 ***	−0.021 ***	0.264 ***
	(−10.957)	(5.096)	(−7.410)	(4.239)	(−15.619)	(11.267)
Boardsize	0.019 **	−0.242 *	0.023 ***	0.263 ***	0.016 ***	−0.281 ***
	(2.409)	(−1.661)	(3.012)	(−2.767)	(3.508)	(−3.558)
TOP1	0.000 ***	0.003 *	0.000 ***	0.005 ***	0.000 ***	0.004 ***
	(4.839)	(1.907)	(3.908)	(4.189)	(7.285)	(3.956)
Constant	−0.377 ***	7.971 ***	−0.369 ***	6.882 ***	−0.319 ***	8.785 ***
	(−9.656)	(8.781)	(−8.562)	(17.886)	(−16.057)	(24.846)
Industry	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Adjusted-R^2	0.283	0.276	0.282	0.279	0.278	0.274
N	3724	3724	4133	4133	4133	4133

Note: Key variables are shown in bold text. The dependent variables are ROA and TobinQ. The independent variable of Column 1 and Column 2 is digfincounty, which is chosen from the "Peking University digital inclusive finance index". The dependent variables of Column 3 and Column 4 are ROE and Profit Margin, which we follow the study of Nakatani (2019) [35]. The independent variable of Column 5 and Column 6 is digfincity_R, which is the residual term of the regression after controlling for the omission of the regional legal environment level, regional financial development level and regional economic development level. We select Wang et al.'s (2018) [36] legal index, which measures the whole institutional development of each province in China and the investor protection of each region. We measure the regional financial development level by the number of banks of each prefecture city, which we obtain from http://www.5cm.cn/bank/. Our last access was on 5 October 2022. We define the regional economic development level using per capita GDP at the prefecture-level city, which is collected manually. The complete definition of the control variables can be found in Appendix A. Cluster-adjusted robust standard errors are in parentheses. ***, ** and * indicate significance levels of 1%, 5% and 10%, respectively.

4.4.2. Controlling the Impact of Macro Influenced Factors

In this section, we examine the effect of macro influenced factors on DIF. Prior studies (Yu and Wang, 2021) [37] show that the regional economic development level, regional financial development level and regional legal environment level are the dominant factors that affect the implementation of DIF. Therefore, we use the two-stage regression method to control the absence of macro influenced factors. First, we take *digfincity* as the dependent variable and *regional* (regional legal environment level), *finance* (regional financial development level) and *GDP* (regional economic development level) as the independent variables to carry out the first-stage regression. Then, we define digital inclusive financial status at the prefecture-level city as *digfincity_R* using the residual term of the regression. Column 5 and Column 6 of Table 4 show that *digfincity_R* is significantly positively correlated with *ROA* and *TobinQ*, which shows that DIF plays a role in improving the financial performance of SMEs.

4.4.3. Test of IV Two-Stage Least Regression

We use two-stage least squares with IV to address the concern of endogeneity issues in terms of omitted variables. We choose the internet penetration rate of prefecture-level cities as the instrumental variable of *digfincity*. As argued by Xie et al. (2018) [38], the internet penetration rate is the proportion of the number of internet users to the total resident population of the prefecture city, which reflects the utilization rate of internet technology at a prefecture-level city. If the internet penetration rate of a prefecture-level city is higher, that means inclusive financial policy can be implemented more conveniently by relying on digital techniques. However, the profitability and sales growth ability of SMEs are the consequences of business activities, which are related indirectly to the internet penetration rate of prefecture-level cities. As such, the IV of the internet penetration rate of prefecture-level cities meets the criteria of a proper IV. That is, it is highly related to the independent variable but not correlated with the error term of empirical Model 1 [39].

We obtain the data of the internet penetration rate of prefecture-level cities from the statistical yearbook of the local government and then include it in Model 1 by two-stage least squares regression. Column 1 of Table 5 reports the result of the first-stage regression. Consistent with our prediction, the IV (*Networking*) is positively associated with *digfincity* at 1% significant level. The results of the second-stage regression are presented in Column 2 and Column 3. The relationship between ROA, TobinQ and Digfincity resembles what we obtain from Table 3. Thus, after controlling the potential endogeneity concern, Table 5 further support and enhance our main conclusion that DIF promotes the financial performance of SMEs.

4.5. Further Test

In this section, we conduct three additional tests to further examine the role of DIF in improving the financial performance of SMEs. In particular, based on our previous conclusion that DIF can play a crucial role in corporate financial decisions, we examine the intermediary effects of the scale of innovative investment, the cost of debt financing and the risk-taking ability. Each test is presented in the following sections.

4.5.1. The Scale of Innovative Investment

Evidence shows that the scale of innovative investment has a positive relationship with the financial performance of SMEs [40,41]. It has long been recognized that firms' innovative investment scale is determined by uncertain output, high regulatory costs and difficult value measurement of innovative activities caused by information asymmetry in the innovation process of SMES [42]. Moreover, the value of innovative activities is difficult to accurately measure in the short term, which further increases the adjustment cost between sustainable innovative investment and the uncertain output of SMEs, which ultimately reduces the scale of innovative investment of SMEs due to financing constraints. DIF can greatly improve the ability of banks to collect and process information that enhances

the motivation of banks to provide credit, which ultimately stimulates the innovative activities of SMEs. Prior studies have shown that the amount of innovative investment is positively related to patent output and ultimately helps to improve the financial performance of SMEs [43,44]. Therefore, DIF may empower the financial performance of SMEs by expanding the scale of innovative investment.

Table 5. Robustness test using IV.

Variable	*Digfincity*	*ROA*	*TobinQ*
	(1)	**(2)**	**(3)**
Networking	**0.000 *****		
	(3.048)		
Digfincity		**1.753 ****	**34.900 ****
		(1.994)	**(2.092)**
Firmsize	−0.001	0.018 ***	−0.269 ***
	(−1.468)	(13.904)	(−9.920)
Salesgrowth	0.001 *	−0.003	−0.079 **
	(1.779)	(−1.378)	(−2.006)
Leverage	−0.002	−0.103 ***	−0.542 ***
	(−1.247)	(−10.657)	(−3.045)
Cashholding	−0.006 **	0.071 ***	0.579 ***
	(−2.086)	(7.251)	(3.214)
SOE	−0.001 *	0.001	−0.106 ***
	(−1.913)	(0.713)	(−2.621)
Firmage	−0.001 ***	−0.018 ***	0.306 ***
	(−2.579)	(−10.168)	(8.914)
Boardsize	0.004 ***	0.008	−0.438 ***
	(2.737)	(1.130)	(−3.558)
TOP1	−0.000 ***	0.001 ***	0.006 ***
	(−3.842)	(5.558)	(3.588)
Constant	0.046 ***	−0.421 ***	6.715 ***
	(5.625)	(−7.115)	(5.808)
Industry	YES	YES	YES
Year	YES	YES	YES
Adjusted-R^2	0.098	0.264	0.235
N	4133	4133	4133

Note: Key variables are shown in bold text. The internet penetration rate of prefecture-level cities is the instrumental variable, which we obtain from the yearbook of the local government. The dependent variables are *ROA* and *TobinQ*. The independent variable is digfincity, which is chosen from the "Peking University digital inclusive finance index". The complete definition of the control variables can be found in Appendix A. Cluster-adjusted robust standard errors are in parentheses. ***, ** and * indicate significance levels of 1%, 5% and 10%, respectively.

To construct such an intermediating role, we construct a simultaneous equation model [Model 2, Model 3 and Model 4] to conduct an empirical test. Model 2 takes *innovation* as the dependent variable and *digfincity* as the independent variable to test the impact of DIF on the scale of innovative investment of SMEs. Prior studies have indicated a positive relationship between DIF and the scale of innovative investment of SMEs [45]. That is, the coefficient of β_1 of Model 2 should be significantly positive. Model 3 takes *ROA* and *TobinQ* as the dependent variable and *innovation* as the independent variable to test the

impact of the scale of innovative investment on the profitability and sales growth ability of SMEs. Cheah et al. (2021) [46] reveal that the financial performance of SMEs improves as the scale of innovative investment increases. That is, the coefficient of β_1 of Model 3 is significantly positive. Model 4 takes *ROA* and *TobinQ* as the dependent variable and *digfincity* and *innovation* as the independent variables to test the intermediating role of the scale of innovative investment. If the coefficients of β_1 and β_2 in Model 4 are both significantly positive, then the empirical results verify the scale of innovative investment to be a path for DIF to affect the financial performance of SMEs. If the coefficient of β_1 of Model 4 is not significant while the coefficient of β_2 is still significantly positive, then this indicates that the scale of innovative investment is the unique way for DIF to affect the financial performance of SMEs.

$$Innovation_{it} = \beta_0 + \beta_1 Digfincity_{it} + \Sigma Controls_{it} + \beta_2 Year + \beta_3 Industry + \varepsilon_{it} \quad (2)$$

$$Performance_{it} = \beta_0 + \beta_1 Innovation_{it} + \Sigma Controls_{it} + \beta_2 Year + \beta_3 Industry + \varepsilon_{it} \quad (3)$$

$$Performance_{it} = \beta_0 + \beta_1 Digfincity_{it} + \beta_2 Innovation + \Sigma Controls_{it} + \beta_3 Year + \beta_4 Industry + \varepsilon_{it} \quad (4)$$

The results in Table 6 show that the coefficients of *Digfincity* in Column 1 and that of innovation in Columns 2 and Columns 3 are all significantly positive. Also, the coefficients of *Digfincity* and Innovation in Columns 4 and Columns 5 are significantly positive as well. This suggests that DIF enhances the financial performance of SMEs by increasing the scale of innovative investment.

Table 6. Further test on the intermediary effect of innovation investment scale between DIF and financial performance.

Variable	***Innovation***	***ROA***	***TobinQ***	***ROA***	***TobinQ***
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Digfincity	**0.000 *****			**0.000 ***	**0.001 ***
	(3.855)			**(1.666)**	**(1.799)**
Innovation		**0.432 *****	**9.224 *****	**0.427 *****	**9.132 *****
		(6.185)	**(6.859)**	**(8.908)**	**(10.772)**
Firmsize	0.001	0.017 ***	−0.290 ***	0.017 ***	−0.290 ***
	(0.979)	(11.258)	(−7.583)	(14.606)	(−11.948)
Salesgrowth	−0.000	−0.001	−0.034	−0.001	−0.035
	(−0.539)	(−0.424)	(−0.937)	(−0.576)	(−1.295)
Leverage	−0.006 *	−0.103 ***	−0.543 ***	−0.104 ***	−0.545 ***
	(−1.961)	(−9.867)	(−2.670)	(−10.851)	(−3.153)
Cashholding	0.016 ***	0.055 ***	0.256	0.055 ***	0.242 *
	(3.108)	(5.376)	(1.488)	(7.267)	(1.908)
SOE	−0.004 ***	0.001	−0.106 **	0.001	−0.107 ***
	(−2.640)	(0.532)	(−2.027)	(0.794)	(−3.455)
Firmage	−0.002 **	−0.020 ***	0.284 ***	−0.020 ***	0.281 ***
	(−2.238)	(−10.649)	(6.894)	(−16.741)	(11.948)
Boardsize	0.004	0.013 **	−0.326 **	0.013 ***	−0.323 ***
	(1.328)	(1.969)	(−2.428)	(2.973)	(−4.031)
TOP1	0.000	0.000 ***	0.004 **	0.000 ***	0.004 ***
	(0.269)	(4.611)	(2.154)	(7.383)	(3.701)

Table 6. *Cont.*

Variable	*Innovation*	*ROA*	*TobinQ*	*ROA*	*TobinQ*
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Constant	−0.039 **	−0.307 ***	8.994 ***	−0.324 ***	8.664 ***
	(−2.446)	(−9.166)	(10.862)	(−12.294)	(16.292)
Industry	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES
Adjusted-R^2	0.251	0.298	0.304	0.298	0.305
N	4133	4133	4133	4133	4133

Note: Key variables are shown in bold text. Innovation is the intermediate variable, which is calculated by R&D expense to annual sales revenue. The dependent variables are *ROA* and *TobinQ*. The independent variable is *digfincity*, which is chosen from the "Peking University digital inclusive finance index". The complete definition of the control variables can be found in Appendix A. Cluster-adjusted robust standard errors are in parentheses. ***, ** and * indicate significance levels of 1%, 5% and 10%, respectively.

4.5.2. The Cost of Debt Financing

The cost of debt financing is the financial cost that is affected by the bank capital cost and the credit risk of SMEs. DIF can help banks to collect idle funds at a lower cost and reduce the dependence of facilities and staff, which is obviously helpful to reduce the operating costs of banks. DIF can help banks to improve their ability to analyze the information of SMEs, which deeply reduces the credit risk of banks. Therefore, compared with traditional inclusive financial policy, DIF can reduce the capital cost and credit risk of banks, which leads to a lower cost of credit provided by banks to SMEs. The prior literature reveals that the cost of debt financing should be deducted before the net profit, which makes the cost of debt financing negatively related to the financial performance of SMEs [47]. Therefore, DIF may affect the financial performance of SMEs by reducing the debt financing cost.

To construct such an intermediating role, we construct a simultaneous equation model group to conduct an empirical test. Table 7 reports the test results. The coefficient of *Digfincity* in Column 1 and the coefficients of *Debtcost* in Column 2 and Column 3 are all significantly negative, which is consistent with our prediction. The coefficients of *Digfincity and Debtcost* in Column 4 and Column 5 are all significant. The T-value of *Digfincity* in Column 4 of Table 7 is 1.567, which is close to 1.660 at the 10% significance level. This indicates that DIF empowers the financial performance of SMEs by reducing the cost of debt financing.

4.5.3. Risk-Taking Ability

Risk-taking ability refers to the ability of SMEs to cope with their financial risks and operating risks, and it depends on the ability of SMEs to use financial information and other operations-related resources. Depending on the capital "amplifier" function of DIF, SMEs can easily acquire financial resources from banks because DIF can break through the time and space constraints to aggregate idle funds and accurately distinguish the real requirement from SMEs, which will be obviously helpful to improve the ability of SMEs to deal with the operating risk. Moreover, DIF can help banks integrate the information of the whole market and the supply chain of credit targeting SMEs by using digital technology that obviously enhances the information-acquisition ability of SMEs on the consideration of loan security. Prior studies have shown that the risk-taking ability of SMEs is positively correlated with the probability and sales growth of SMEs [48], and all these factors are conducive to the intermediation of risk-taking ability between DIF and financial performance.

Table 7. Further test on the intermediate effect of debt financing cost between DIF and financial performance.

Variable	*Debtcost*	*ROA*	*TobinQ*	*ROA*	*TobinQ*
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Digfincity	**−0.000 ***			**0.000**	**0.002 ****
	(−1.919)			**(1.567)**	**(2.195)**
Debtcost		**−0.925 *****	**−6.964 *****	**−0.921 *****	**−6.860 *****
		(−11.790)	**(−3.904)**	**(−11.735)**	**(−3.812)**
Firmsize	0.001 *	0.019 ***	−0.278 ***	0.019 ***	−0.278 ***
	(1.803)	(12.719)	(−8.451)	(12.777)	(−8.506)
Salesgrowth	−0.002 ***	−0.003	−0.050	−0.003	−0.051
	(−3.016)	(−1.412)	(−1.566)	(−1.435)	(−1.629)
Leverage	0.026 ***	−0.082 ***	−0.415 *	−0.082 ***	−0.421 *
	(7.582)	(−7.995)	(−1.815)	(−8.043)	(−1.841)
Cashholding	−0.024 ***	0.040 ***	0.240	0.039 ***	0.221
	(−8.829)	(4.649)	(1.402)	(4.621)	(1.296)
SOE	0.002 **	0.001	−0.128 ***	0.001	−0.129 ***
	(2.388)	(0.646)	(−3.027)	(0.628)	(−3.049)
Firmage	0.002 ***	−0.018 ***	0.280 ***	−0.019 ***	0.277 ***
	(4.423)	(−8.657)	(7.117)	(−8.753)	(7.109)
Boardsize	−0.005 ***	0.010	−0.322 **	0.011	−0.318 **
	(−2.663)	(1.510)	(−2.431)	(1.527)	(−2.404)
TOP1	−0.000 ***	0.000 ***	0.003 *	0.000 ***	0.003 *
	(−5.051)	(4.100)	(1.860)	(4.068)	(1.838)
Constant	0.020 *	−0.302 ***	8.924 ***	−0.322 ***	8.450 ***
	(1.878)	(−8.517)	(12.884)	(−8.191)	(11.932)
Industry	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES
Adjusted-R^2	0.331	0.324	0.286	0.325	0.287
N	4133	4133	4133	4133	4133

Note: Key variables are shown in bold text. Debtcost is the intermediate variable, which is calculated by financial cost to annual sales, which we obtain from the CSMAR database. The dependent variables are *ROA* and *TobinQ*. The independent variable is digfincity, which is chosen from the "Peking University digital inclusive finance index". The complete definition of the control variables can be found in Appendix A. Cluster-adjusted robust standard errors are in parentheses. ***, ** and * indicate significance levels of 1%, 5% and 10%, respectively.

To construct such an intermediating role, we construct another simultaneous equation model group to conduct the empirical test. Table 8 reports the test results. The coefficient of *Digfincity* in Column 1 and the coefficients of *Risktaking* in Column 2 and Column 3 are significantly positive, which is consistent with our prediction. The coefficients of *Digfincity and Risktaking* in Column 4 and Column 5 are all significant, indicating that DIF empowers the financial performance of SMEs by strengthening their risk-taking ability.

Table 8. Further test on the intermediate effect of risk-taking ability between DIF and financial performance.

Variable	*Risktaking*	*ROA*	*TobinQ*	*ROA*	*TobinQ*
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Digfincity	**0.001 ***			**0.000 ***	**0.002 ****
	(1.867)			**(1.885)**	**(2.046)**
Risktaking		**0.008 ***	**0.577 *****	**0.008 ***	**0.573 *****
		(1.845)	**(6.990)**	**(1.795)**	**(6.945)**
Firmsize	0.014 **	0.018 ***	−0.292 ***	0.018 ***	−0.292 ***
	(2.004)	(11.490)	(−8.804)	(11.546)	(−8.846)
Salesgrowth	0.018	−0.001	−0.048	−0.001	−0.049
	(1.264)	(−0.630)	(−1.540)	(−0.667)	(−1.605)
Leverage	−0.004	−0.106 ***	−0.593 ***	−0.106 ***	−0.596 ***
	(−0.105)	(−8.889)	(−2.642)	(−8.926)	(−2.657)
Cashholding	0.033	0.062 ***	0.388 **	0.061 ***	0.368 **
	(0.547)	(6.298)	(2.130)	(6.284)	(2.043)
SOE	0.037 **	−0.001	−0.161 ***	−0.001	−0.162 ***
	(2.395)	(−0.238)	(−3.644)	(−0.254)	(−3.646)
Firmage	0.131 ***	−0.022 ***	0.189 ***	−0.022 ***	0.186 ***
	(13.629)	(−9.277)	(4.629)	(−9.376)	(4.598)
Boardsize	−0.065 *	0.016 **	−0.248 *	0.016 **	−0.245 *
	(−1.819)	(2.110)	(−1.912)	(2.123)	(−1.891)
TOP1	−0.000	0.000 ***	0.004 **	0.000 ***	0.004 **
	(−0.609)	(5.738)	(2.570)	(5.669)	(2.543)
Constant	−0.045	−0.315 ***	8.773 ***	−0.340 ***	8.335 ***
	(−0.197)	(−8.596)	(12.754)	(−8.561)	(12.036)
Industry	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES
Adjusted-R^2	0.159	0.278	0.299	0.279	0.300
N	4133	4133	4133	4133	4133

Note: Key variables are shown in bold text. Risktaking is the intermediate variable, which is calculated by the standard deviation of the return rate of the stock from t − 2 to t + 2. The dependent variables are *ROA* and *TobinQ*. The independent variable is digfincity, which is chosen from the "Peking University digital inclusive finance index". The complete definition of the control variables can be found in Appendix A. Cluster-adjusted robust standard errors are in parentheses. ***, ** and * indicate significance levels of 1%, 5% and 10%, respectively.

5. Conclusions

This paper selects data of SMEs from CSMAR database, together with data from "Peking University digital inclusive finance index" compiled and maintained by the digital finance research center of Peking University, to theoretically induce and empirically test the relationship between DIF and the financial performance of SMEs. The conclusions of this paper are as follows. First, DIF can play a role in improving the financial performance of SMEs, and the result is still persistent after several robust tests. Second, DIF continuously improves the financial performance of SMEs by expanding the scale of innovative investment, reducing the cost of debt financing and strengthening the risk-taking ability.

Our findings have important implications. First, the government should be committed to accelerating the infrastructure construction of DIF, promoting the digital reform of the financial system and accurately enabling the business development goals of SMEs. Therefore, the government should continue to improve the basic financial credit database

and promote the integrated construction of local credit information platforms to realize the exchange and sharing of cross-regional, cross-industry and cross-period enterprise credit information. Second, banks and other financial institutions should actively respond to the digital inclusive financial policy advocated by the government and formulate appropriate financial support plans for the survival status and development needs of SMEs. Banks and other financial institutions should rely on digital technology to scientifically and reasonably evaluate the risks of SMEs to avoid the present situation of credit difficulty for SMEs. Third, SMEs should strengthen their modern financial awareness, fully grasp the opportunity for the development of DIF and effectively use digital inclusive financial policy to achieve the goal of sustainable development.

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Appendix A

Table A1. Variable definition.

Variable	Definition
ROA	A ratio of net profit to total assets
TobinQ	A ratio of market value to replacement cost
Digfincity	Digital inclusive financial index at prefecture level
Firmsize	The nature logarithm of total assets
Salesgrowth	A ratio of sales growth compared with previous year
Leverage	A ratio of total debt to total assets
Cashholding	A ratio of total cash and cash equivalents to total assets
SOE	A dummy variable, equaling to 1 when the ultimate controlling shareholder of a listed firm is a (central or local) government agency or government controlled SOE and 0 otherwise
Firmage	The nature logarithm of the age of firm for the year
Boardsize	The nature logarithm of number of chairman board
TOP1	The ratio of Shares held by the largest shareholder to total firms' total shares
Riskingtaking	Standard deviation of the return rate of the stock from t − 2 to t + 2
Innovation	A ratio of R&D expenditure to sales income
Debtcost	A ratio of financial cost to total liabilities

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