

Analysis of the Impact of Digital Finance on the Financing Constraints of Small and Medium-Sized Enterprises

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Abstract

High financing constraints hinder the development of SMEs, and digital finance, as a new way to support SME financing, may become an effective means to break through SME financing constraints and reduce financing costs. This paper uses the cross-sectional data of SMEs listed on the SMB from 2011 to 2020 as a sample, and builds an empirical test model based on the cash-cash flow sensitivity model for empirical research. The study shows that digital finance has a significant mitigating effect on the financing constraints of SMEs. In addition, the impact of digital finance on private and high-tech enterprises is greater than that of state-owned enterprises and non-high-tech enterprises. Moreover, the development of digital finance in eastern China can significantly alleviate the degree of financing constraints of SMEs listed on the SME board, while the development of digital finance in central and western China has no significant alleviating effect, showing significant geographical heterogeneity.

Keywords: *Digital finance; Small and medium-sized enterprises; Financing constraints.*

1 Introduction

SMEs are the driving force of China's national economy and social development, and their contribution in promoting China's economic development, safeguarding people's livelihood, and promoting innovation and entrepreneurship is enormous. However, SMEs in China generally have the outstanding problem of "difficult and expensive financing" and face serious financing constraints ^{Error! Reference source not found.}, which makes them poorly resilient to risks, and a large number of them face the risk of cash flow breakage under the influence of various unexpected factors. The traditional financial model operates on the basis of enterprise scale, ownership attributes, collateral and other "hard information" of enterprises, which leads to a more serious financing constraint for SMEs ^{Error! Reference source not found.}. As a new financial service model, digital finance lowers the threshold of financial services and the cost of financial transactions, improves the coverage and service efficiency of traditional finance, and brings new opportunities to alleviate the financing constraints of SMEs ^{Error! Reference source not found.}.

The main contributions of this paper are: (1) based on the theoretical models of jean ladder rohr, credit rationing, and collateral of information asymmetry in corporate finance theory, a theoretical model of credit between SMEs and suppliers of funds is constructed, and the theoretical model is used to argue whether and what impact digital finance has on

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SME financing. (2) Deepened the application of theories such as information asymmetry, argued the economic logic of digital finance to alleviate the financing constraints of SMEs, and enriched the theoretical evidence that digital finance promotes SME financing. (3) From the perspective of digital finance, it provides a new perspective for exploring effective ways to alleviate the financing constraints of SMEs, which is of practical significance for accelerating the promotion of digital financial services for SMEs.

2 Literature Review

The first small climax of China's research on SME financing emerged during 2001-2003, and many scholars discussed the causes of SME financing difficulties and coping strategies from the aspects of bank structure, small and medium-sized financial institutions and credit guarantee system Error! Reference source not found., and these studies put forward positive theoretical preparations and policy recommendations for the reform of China's financial field and the problem of SME financing constraints at that time. With the accelerated integration of information technology and economy, many scholars at home and abroad have theoretically analyzed digital finance to alleviate the financing constraints of SMEs from the perspectives of Internet finance, technology finance, and digital inclusion, and the current study shows that digital finance can alleviate the financing constraints of SMEs.

Research on digital finance on SME financing constraints based on quantitative perspective never stops. chung Jay M et al. (2017) pointed out that platform finance relying on information technology is becoming an alternative financing method for SMEs Error! Reference source not found.. Zou W (2018) constructed an index of the level of development of inclusive finance in China and conducted an empirical test, finding that inclusive finance can increase the proportion of SMEs' financing from financial institutions and play a positive role in reducing SMEs' financing constraints Error! Reference source not found.. Liang Bang (2018) studied the sample firms based on cash-cash flow sensitive model and found that the coverage and depth of use of digital finance alleviated the financing constraints of SMEs Error! Reference source not found.. Kaa Etal (2020) found that fintech can help improve the efficiency of SMEs through a survey of OECD 1617 SMEs Error! Reference source not found.. Qi Liang (2020) used Tobi model to study the financing constraint leverage of MSMEs and found that the use of digital finance by MSMEs can both alleviate the financing constraint and in turn reduce the leverage Error! Reference source not found.. Wan Jia Yu (2020) conducted an empirical study using Peking University's Digital Inclusive Finance Index and found that digital finance has a significant effect on reducing corporate financing constraints Error! Reference source not found.. Jian He et al. (2021) also found through empirical analysis that digital finance can provide effective services for SME financing Error! Reference source not found..

From the perspective of the mechanisms and pathways through which digital finance affects the financing constraints of SMEs, the current literature develops from several perspectives. By analyzing the credit model of digital finance, Zheng et al. (2015) argue that digital finance can promote financial disintermediation and alleviate the financing constraint of SMEs Error! Reference source not found.. Xu Lin et al. (2019) used principal component analysis to calculate the comprehensive index of Internet development level and constructed a cash-cash flow sensitivity model to test the role of Internet finance development on SME financing, and the empirical results showed that the development of Internet finance can alleviate SME financing constraints to a certain extent Error! Reference source not found.. Zhang Lei et al. (2020) proposed that digital finance alleviates SME financing constraints mainly from three aspects:improving trust between the supply and demand of funds, enhancing the degree of matching between the supply and demand of funds, using intelligent risk control mechanisms to improve the operational efficiency of

enterprises, and reducing financing costs and default risks Error! Reference source not found. Yin Yingkai (2020) used systematic GMM estimation using banking industry structure and SME data and found that the development of digital finance enables small and medium-sized banks to serve SME financing more effectively, without any significant impact on large banks Error! Reference source not found. Ying Xue et al. (2020), on the other hand, argue that the wind control tools of big data in digital finance have lowered the financing threshold of innovative and private enterprises Error! Reference source not found.

In summary, scholars have a richer literature on the study of SME financing dilemmas and have begun to focus on the role of the Internet and digital technology in solving SME financing dilemmas. Regarding the practical impact of digital finance on the financing problems of SMEs, but mostly using data from listed companies for their econometric empirical analysis, and not enough attention to SMEs, this paper argues that with the development of digital technology, the problem of financing constraints for SMEs should be given sufficient attention, and the study of the impact of digital finance on the financing constraints of SMEs is of great significance to crack the financing dilemma of SMEs.

3 Theoretical Analysis and Research Hypotheses

3.1 Analysis and hypothesis of the path of digital finance constraints on SME financing

First, this paper hypothesizes that the development of digital finance in China can alleviate the financing constraints of SMEs. As the traditional financing model of SMEs usually requires high risk assessment such as transaction costs to obtain credit support or even unavailable financing support, the part of traditional collateral is replaced by credit collateral due to the lack of collateral and innovative financing by digital finance to speed up the loan approval process and reduce the information and transaction costs of SMEs. Many researchers argue that information asymmetry can cause enterprises to face financing constraints, and the most critical function of digital finance is to use digital technology to greatly reduce the information asymmetry between SMEs and the suppliers of funds, increasing the probability and scale of SMEs' access to financing support. Since the sample source of this chapter is listed companies in the SMB, research hypothesis 2.1 is proposed.

H2.1: The higher the degree of digital finance development, the lower the degree of financing constraint of small and medium-sized listed companies, i.e., there is a negative relationship between digital finance development and financing constraint of small and medium-sized listed companies.

3.2 Analysis and hypothesis of the impact of digital finance on financing constraints of SMEs with different ownership nature

Since SOEs and private enterprises differ more significantly for various reasons, the effect of digital finance on alleviating SME financing constraints may also differ due to the different nature of enterprise ownership. Compared with private enterprises, SOEs have closer social networks, mainly in the form of stronger government-enterprise and bank-enterprise relationships, which makes SOEs more transparent in terms of information, and the government is often their implicit guarantor. As a result, banks and other financial institutions are more inclined to provide financing to SOEs considering loan costs, risks and other factors, so they face fewer financing constraints compared to private enterprises. However, due to the development of digital finance, information processing is easier and faster, risk assessment is cheaper and more accurate, credit level is more open and transparent, financial marketization can promote fairness and perfection of transactions, and SMEs are no longer discriminated because of ownership issues, which improves the probability of obtaining loans and reduces financing constraints. Based on the above analysis, hypothesis 2.2a is proposed in this paper.

H2.2a: Among listed companies, private SMEs have been more relieved of their financing constraints due to the development of digital finance compared to state-owned SMEs.

3.3 Analysis and hypothesis of the impact of digital finance on the financing constraints of enterprises in different regions

Because of the large differences in the level of economic development and other aspects between the eastern and western regions of China, with the better development in the eastern region evident, it is presumed that the degree of alleviation of digital finance constraints for SMEs varies from region to region. Digital finance provides a new way to solve the financing problems of SMEs. Compared with traditional financing models, it is less restricted by geography, has stronger geographical penetration, and can cover a wide range of long-tail groups. Moreover, the role of digital finance is more imaginative in the central and western regions, which are also relatively poor in terms of macroeconomics, institutional environment and overall credit level, and their SME financing constraints are more severe. Therefore, from this perspective, the role of digital finance should be more significant in the central and western regions than in the relatively developed eastern regions. On the basis of the above analysis, Hypothesis 2.2b is proposed.

H2.2b: The extent to which digital finance alleviates the financing constraints of listed SMEs varies due to different regions in China. The extent to which digital finance alleviates the financing constraints of SMEs in the central and western regions is greater than that in the eastern regions.

3.4 Analysis and hypothesis of the impact of digital finance on financing constraints of SMEs of different industry nature

The characteristics of high-tech SMEs with intensive R&D investment and light assets make their financing constraints more serious than those of non-high-tech SMEs. Both foreign scholars Brown et al. (2010), and domestic scholars Zhang Yuan et al. (2018) and Zhang Xuan et al. (2017) argue that high-tech enterprises face more pronounced financing constraints. R&D and innovation activities are characterized by long transition cycles and high uncertainty, and SMEs have difficulties in meeting their own internal financing needs. In addition, high-tech SMEs have less collateral, higher credit risk, and limited and unstable cash flow due to their asset-light and technology-heavy characteristics, which makes it difficult for financial institutions to provide them with financing support after assessment and review. The digital finance model, on the other hand, relies on advanced digital technology and risk control models, uses the rich information of enterprises in all dimensions to evaluate and predict future development, identifies high-tech enterprises with less actual risk and higher potential, and can replace some of the traditionally used corporate credit collateral, which well solves the financing constraints of high-tech enterprises and increases financing support for high-tech SMEs. Based on the above analysis, the following hypothesis 2.2c is proposed.

H2.2c: Among listed companies, compared to non-high-tech SMEs, high-tech SMEs are influenced by the development of digital finance and their financing constraints are alleviated to a greater extent.

4 Research Design

4.1 Model construction and variable description

To test the above hypotheses, this chapter develops an empirical research model based on the cash-cash flow sensitivity model proposed by Almeida et al. (2004). The model of corporate financing constraints is shown in 3.1.

$$\frac{\Delta\text{Cash}_{it}}{A_{it-1}} = a_0 + a_1 \frac{\text{CF}_{it}}{A_{it-1}} + a_2 \text{Grow}_{it} + a_3 \text{Size}_{it} + a_4 \frac{\Delta\text{NWC}_{it}}{A_{it-1}} + a_5 \frac{\Delta\text{SD}_{it}}{A_{it-1}} + a_6 \frac{\Delta\text{Expend}_{it}}{A_{it-1}} + u_{it} \quad (3.1)$$

In the above equation, A represents the total assets of the enterprise, ΔCash_{it} represents the change of the Cash and Cash equivalents holding of the enterprise, CF_{it} represents the Cash flow of the enterprise, and its coefficient a_1 is the focus of the model. A significant positive value of a_1 indicates that the cash-cash flow sensitive coefficient of the enterprise is strong, and the enterprise has financing constraints.

The variables in equation 3.1 are simplified by dividing them by the total assets of the previous period and incorporating them in the calculation of the variables themselves. The benchmark analysis framework is set as follows:

$$\Delta\text{Cash}_{it} = a_0 + a_1 \text{CF}_{it} + a_2 \text{Grow}_{it} + a_3 \text{Size}_{it} + a_4 \Delta\text{NWC}_{it} + a_5 \Delta\text{SD}_{it} + a_6 \Delta\text{Expend}_{it} + u_{it} \quad (3.2)$$

According to the data characteristics of this paper, time control variables (year dummy variables) and industry control variables (industry dummy variables) are added to obtain the baseline model of this paper as follows:

$$\Delta\text{Cash}_{it} = a_0 + a_1 \text{CF}_{it} + a_2 \text{Grow}_{it} + a_3 \text{Size}_{it} + a_4 \Delta\text{NWC}_{it} + a_5 \Delta\text{SD}_{it} + a_6 \text{Expend}_{it} + \text{Yeardummy} + \text{Industrydummy} + u_{it} \quad (3.3)$$

Then, the interaction term between digital finance and corporate cash flow is added to the model to construct the extended model 3.4.

$$\Delta\text{Cash}_{it} = a_0 + a_1 \text{CF}_{it} + \varphi_1 \text{CF}_{it} \times \text{DIFI}_{it} + a_2 \text{Grow}_{it} + a_3 \text{Size}_{it} + a_4 \Delta\text{NWC}_{it} + a_5 \Delta\text{SD}_{it} + a_6 \text{Expend}_{it} + \text{Yeardummy} + \text{Industrydummy} + u_{it} \quad (3.4)$$

In the above equation, the sign and significant performance of coefficient a_1 are sufficient to judge whether the enterprise has financing constraints. A significant positive value of a_1 indicates that the enterprise has obvious financing constraints. $\varphi_1 \text{CF}_{it} \times \text{DIFI}_{it}$ is the interaction term between digital finance and corporate cash flow, and the coefficient φ_1 is also the focus of our attention. If φ_1 is significantly negative, it indicates that the development of digital finance can alleviate the financing constraints of smes.

The control variables are as follows: Grow_{it} represents the growth of the enterprise, and the higher growth of the enterprise means that the enterprise has higher investment opportunities in the future; Size_{it} represents the Size of the enterprise. Large-scale enterprises face relatively small financing constraints. ΔNWC_{it} represents the change in working capital; ΔSD_{it} represents the change of short-term liabilities, enterprises often take short-term liabilities as the replacement of cash flow; Expend_{it} represents enterprise capital expenditure.

Tab 1 Variable definition and description

Variable type	Variable name	Variable symbol	Variable declaration
Dependent variable	Changes in corporate cash holdings	ΔCash	(Net increase in cash and cash equivalents/total assets at beginning of period)*100

Independent variable	Digital Finance Index	DIFI	From the digital Financial Inclusion Index of Peking University, all indices were divided by 100 in order to unify the data magnitude
	Digital Financial Coverage Breadth Index	DIFI_CB	
	Digital finance use depth index	DIFI_UD	
	Degree of digitization index	DIFI_DL	
	Enterprise cash flow	CF	
Control variables	Enterprise growth ability	Grow	Year-on-year growth rate of operating revenue *100
	The enterprise scale	Size	Natural log of total ending assets
	Changes in the net working capital of the enterprise	Δ NWC	(Net working capital increase/total assets at the beginning of the period)*100
	Corporate short-term debt changes	Δ SD	(Increase in liquid liabilities/total assets at the beginning)*100
	Long-term corporate capital expenditures	Expend	Long-term asset expenditures (cash expenditures for the purchase and construction of fixed assets, intangible assets and other long-term assets)/ Total assets at the beginning of the period *100
	Year variable dummy	Yeardummy	0 -I dummy variable
	Industry variable dummy	Industrydummy	0 -I dummy variable

4.2 Data source

In this chapter, the Digital Finance Index of Peking University compiled by Guo Feng et al. (2020) is selected as a metric of digital finance. The latest updated data from 2011 - 2020 were selected. To ensure the consistency of data caliber, municipal indicators are uniformly used for 2011 - 2020. In addition to the DIFI composite index of digital finance and the DIFI_CB sub-index covering the breadth of digital finance, DIFI_UD Digital Finance uses UsageDepth and DIFI_DL DigitizationLevel to represent the development of each dimension of digital finance.

The SME data are obtained from the wind database of the SME segment of the a-share market. In terms of time selection, data from 2011 - 2020 are selected in order to match the enterprise data with the digital finance index. According to the news released by the Shenzhen Stock Exchange and the Securities Regulatory Commission, the SME Board will be merged into the Shenzhen Main Board on April 6, 2021, but the idea of the merger is "two unified, four unchanged", the original listing conditions, business rules, investor thresholds and trading mechanisms remain unchanged, which generally has little impact

on the market, and the data selected for this study are from 2011 to 2020. From 2011 to 2020, not affected by this policy.

4.3 Descriptive statistics

After excluding financial companies, *ST, ST, PT companies and companies with missing financial data from the data collected from Wind database, we got 58,865 observations from 612 SMEs.

Tab 2 Descriptive statistics

Variable	Observation of the number	average	median	standard deviation	minimum	maximum
DIFI	5865	1.938	2.000	0.688	0.290	3.216
DIFI_CB	5865	1.930	2.016	0.657	-0.105	3.109
DIFI_UD	5865	1.923	1.858	0.714	0.125	3.320
DIFI_DL	5865	1.995	2.277	0.874	0.036	4.379
Cash	5865	2.288	0.113	15.500	-26.460	88.830
CF	5865	5.959	5.586	8.583	-20.540	33.770
Grow	5865	15.890	11.990	27.750	-42.450	141.200
Size	5865	21.870	21.780	0.940	19.920	24.520
NWC	5865	3.788	2.533	11.040	-23.290	47.370
ΔSD	5865	6.620	4.024	13.990	-21.930	74.560
Expend	5865	7.298	5.032	7.170	0.093	38.460
CF*DIFI	5865	11.700	9.906	17.140	-63.400	97.770
CF*DIFI_CB	5865	11.630	9.893	17.080	-60.160	98.600
CF*DIFI_UD	5865	11.600	9.748	17.040	-66.130	99.820
CF*DIFI_DL	5865	12.110	9.465	18.180	-69.110	104.100

Descriptive statistics show that the level of development of digitalization is generally high, but there are large differences between regions in different years. The mean value of digital finance index D is about 2, and the maximum and minimum values are 0.29 and 3.216, respectively, indicating that the level of digital finance development varies widely among different regions, but the overall development is fast. At the same time, it shows that the overall level of digitalization is high, but there are large differences between different regions in different years. In terms of enterprise variables, except for the small difference in enterprise size (with a standard deviation of 0.94), the other variables have a large fluctuation, and the minimum values of all variables are negative, except for long-term capital expenditure spending Expend, which has no negative value.

5 Empirical Results and Analysis

5.1 Empirical results and analysis

5.1.1 Analysis of OLS benchmark regression results

To validate H2.1, this subsection reports OLS regression estimates with controls and industry benchmarks. Column (1) of Table 3 shows the benchmark model without the

interaction, column (2) shows the extended model with the interaction of the digital finance index and cash flow, and columns (3) to (5) show the extended model with the interaction of the digital finance classification index and cash flow.

Tab 3 OLS benchmark regression estimation results

Variable	(1)	(2)	(3)	(4)	(5)
	Cash	Cash	Cash	Cash	Cash
CF	0.395***	0.557***	0.518***	0.574***	0.564***
	(16.11)	9 (9.159)	(8.334)	(9.641)	(11.25)
CF*DIFI		-0.0894***			
		(-2.913)			
CF*DIFI_CB			-0.681**		
			(-2.165)		
CF*DIFI_UD				0.0981***	
				(-3.245)	
CF*DIFI_DL					0.0930***
					(-3.782)
Grow	0.0149*	0.0147*	0.0148*	0.0147*	0.0149*
	(1.925)	(1.905)	(1.908)	(1.896)	(1.924)
Size	0.0167	0.0527	0.0413	0.0554	0.0679
	(0.0685)	(0.216)	(0.169)	(0.227)	(0.278)
NWC	0.100***	0.105***	0.103***	0.106***	0.107***
	(5.222)	(5.465)	(5.380)	(5.509)	(5.556)
SD	0.0990***	0.101***	0.100***	0.101***	0.102***
	(6.346)	(6.460)	(6.431)	(6.446)	(6.514)
Expend	0.0929***	0.0918***	0.0916***	0.0920***	0.0936***
	(3.039)	(3.005)	(2.996)	(3.012)	(3.066)
Cons-	2.021	0.634	1.004	0.547	0.322
	-0.375	-0.117	-0.186	-0.101	-0.0596
Yearfixedeffect	control	control	control	control	control
Industryfixedeffects	control	control	control	control	control
N	5865	5865	5865	5865	5865
Adj.R2	0.095	0.093	0.094	0.095	0.094

Note: Robust T-statistics in parentheses; ***, **, and * represent significant at 1%, 5% and 10% significance levels, respectively.

By viewing the regression results in columns (1)-(5), it can be found that the individual control variables do not vary significantly across the models. The coefficients of the interaction terms of digital finance and cash flow in models (2)-(5) are significantly negative, indicating that the development of digital finance significantly reduces the cash

and cash flow sensitivity of SMEs and effectively alleviates the degree of financing constraints of SMEs. In terms of the digital finance sub-indicators, the degree of digitization and the depth of digital finance usage have the strongest effect on the alleviation of SMEs' financing constraints with coefficients of -0.093 and -0.0981, respectively, and both are significant at the 1% significance level. The financing support effect of breadth of digital financial coverage is also more pronounced, with a significant negative coefficient at the 5% level (coefficient of -0.0681). This indicates that the development of digital finance can alleviate the financing constraints of SMEs, with a stronger effect of depth of use and digitization. The regression results support hypothesis 2.1.

5.1.2 Analysis of panel fixed effect model results

To further verify the accuracy of H2.1, this section is re-estimated by the panel fixed effects model through the base model 3.3 and the extended model 3.4 according to the characteristics of the firm data used, and the estimation results are shown in Tables 4 and 5.

Tab 4 Individual fixed effects model regression estimation results

Variable	(1)	(2)	(3)	(4)	(5)
	Cash	Cash	Cash	Cash	Cash
CF	0.509***	0.794***	0.767***	0.826***	0.732***
	(9.783)	(6.386)	(5.942)	(6.905)	(7.031)
CF*DIFI		0.159***			
		(3.017)			
CF*DIFI_CB			0.143**		
			(2.558)		
CF*DIFI_UD				0.179***	
				(3.626)	
CF*DIFI_DL					0.124***
					(3.022)
Grow	0.0172	0.0157	0.0157	0.0162	0.0157
	(1.645)	(1.499)	(1.496)	(1.550)	(1.494)
Size	1.218***	2.082***	1.914***	2.213***	2.097***
	(3.056)	(4.498)	(4.164)	(4.957)	(4.463)
NWC	0.124***	0.128***	0.128***	0.129***	0.129***
	(3.750)	(3.858)	(3.831)	(3.892)	(3.860)
SD	0.0749***	0.0757***	0.0760***	0.0741***	0.0765***
	(3.003)	(3.046)	(3.058)	(2.989)	(3.076)
Expend	0.225***	0.202***	0.205***	0.202***	0.203***
	(3.697)	(3.254)	(3.292)	(3.258)	(3.279)
Cons-	30.27***	48.82***	45.21***	51.66***	49.16***
	(-)	(-)	(-)	(-)	(-)

	3.419)	4.785)	4.463)	5.233)	4.751)
Individual fixed effects	control	control	control	control	control
N	5865	5865	5865	5865	5865
Adj.R2	0.025	0.023	0.026	0.031	0.027

Tab 5 Estimation results of two-way fixed effects model regression

Variable	(1)	(2)	(3)	(4)	(5)
	Cash	Cash	Cash	Cash	Cash
CF	0.498*** (9.681)	0.670*** (5.145)	0.645*** (4.814)	0.693*** (5.458)	0.644*** (5.914)
CF*DIFI		0.0862*** (2.580)			
CF*DIFI_CB			0.0820** (2.043)		
CF*DIFI_UD				0.110*** (3.065)	
CF*DIFI_DL					0.0818** (2.863)
Grow	0.00841 (0.789)	0.00819 (0.768)	0.00820 (0.769)	0.00809 (0.757)	0.00839 (0.786)
Size	3.636*** (5.287)	3.707*** (5.397)	3.690*** (5.357)	3.723*** (5.460)	3.710*** (5.390)
NWC	0.0881*** (2.753)	0.0941*** (2.943)	0.0927*** (2.907)	0.0951*** (2.964)	0.0947*** (2.960)
SD	0.0678*** (2.778)	0.0700*** (2.871)	0.0697*** (2.856)	0.0698*** (2.866)	0.0704*** (2.890)
Expend	0.126** (2.049)	0.125** (2.022)	0.124** (2.014)	0.125** (2.026)	0.126** (2.050)
Cons-	74.59*** (-5.149)	76.64*** (-5.302)	76.16*** (5.250)	77.04*** (5.376)	76.78*** (5.299)
Individualfixedeffects	control	control	control	control	control
Yearfixedeffect	control	control	control	control	control
N	5865	5865	5865	5865	5865
Adj.R2	0.055	0.053	0.056	0.054	0.059

Note: Robust T-statistics in parentheses; ***, **, and * represent significant at 1%, 5% and 10% significance levels, respectively.

In terms of the control variables, the regression results under the fixed effects model are slightly different from Table 3. The growth of the firm is no longer significant and the size of the firm is significantly positive, indicating that larger firms have the ability to hold more cash.

It is clear from Tables 4 and 5 that the coefficient of the interaction term between digital finance and cash flow is still significantly negative. In the individual fixed effects model, the coefficients of the sub-indexes of digital finance and its reduction of cash and cash flow sensitivity of SMEs are -0.159, -0.143, -0.179 and -0.124, respectively. It can be seen that the depth of use of digital finance has the greatest impact and the absolute value of the coefficient becomes larger in the individual fixed effects model and is significant at 5% or 1% level of significance. In the two-way fixed effects model, the absolute values of the coefficients of the digital finance and cash flow interaction terms are not significantly different from the OLS benchmark regression model and remain significantly negative at the 5% or 1% level, verifying the accuracy of hypothesis 2.1 in a more stringent model setting.

5.1.3 Analysis of Results of Generalized Moment Estimation (GMM model)

To further validate H2.1 and test the robustness of the alleviation effect of digital finance on SMEs' financing constraints, this section refers to the research model of Lian Yujun (2008) and uses the second and third lagged terms of cash flow CF and the first and second lagged terms of firm growth Grow as instrumental variables for further validation. The regression results are shown in Table 6 below:

Tab 6 Regression estimation results of system GMM model

Variable	(1)	(2)	(3)	(4)	(5)
	Cash	Cash	Cash	Cash	Cash
CF	0.254** (2.429)	0.582*** (2.875)	0.598*** (2.771)	0.508*** (2.691)	0.575*** (3.261)
CF*DIFI		0.186** (2.015)			
CF*DIFI_CB			0.198* (1.937)		
CF*DIFI_UD				0.145* (1.753)	
CF*DIFI_DL					0.174** (2.333)
Grow	0.0259** (2.549)	0.0263** (2.575)	0.0266*** (2.629)	0.0259** (2.522)	0.0260** (2.530)
Size	0.315 (1.383)	0.371 (1.613)	0.365 (1.581)	0.360 (1.570)	0.391* (1.704)
NWC	0.0552 (1.259)	0.0659 (1.532)	0.0641 (1.488)	0.0624 (1.455)	0.0728* (1.690)
SD	0.0845*** (3.684)	0.0883*** (3.887)	0.0879*** (3.874)	0.0867*** (3.811)	0.0910*** (4.000)

Expend	0.146**	0.134**	0.134**	0.136**	0.133**
	(2.559)	(2.404)	(2.403)	(2.443)	(2.405)
Cons-	1.519	0.478	0.233	1.516	0.701
	(0.165)	(0.0512)	(0.0244)	(0.166)	(0.0763)
N	5865	5865	5865	5865	5865
DWHtest (P values)	0.0019	0.0025	0.0033	0.0016	0.0022
AR(1) (P values)	0.008	0.015	0.017	0.009	0.01
AR(2) (P values)	0.187	0.206	0.215	0.193	0.238
Sargantest (P values)	0.204	0.368	0.343	0.32	0.457
HansenJ (P values)	0.221	0.215	0.219	0.196	0.237

Note: Robust T-statistics in parentheses; ****, **, and * represent significant at 1%, 5% and 10% significance levels, respectively.

From the results of AR(1) and AR(2), the p-values of model AR(1) in the table are less than 0.5, indicating that the differences of the disturbance terms present first-order autocorrelation, and AR(2) are greater than 0.1, indicating that the second-order difference posterior can solve the autocorrelation problem and is suitable for using the systematic GMM model. The GMM estimation results show that even after controlling for the endogeneity of the model, listed SMEs still face external financing constraints. The estimated coefficients of the digital finance and corporate cash flow interaction terms in columns (2) to (5) are negative at either the 5% or 10% significance level, slightly lower than other models but still significant, and their absolute values are larger than other estimation methods. The alleviation of SME cash cash flow sensitivity is also demonstrated for the digital finance sub-indicator. The estimation results again support the null hypothesis H2.1, indicating that the alleviation of SME financing constraints by digital finance is robust.

5.2 Endogeneity Analysis

To further reduce the endogeneity bias and verify the validity of the selected instruments, the instrumental variables method (2SLS) is applied for further validation.

This paper uses the method of calculating growth rates and extrapolates the Internet penetration rate to 19 years using data from 2011 to 2018 to derive the Internet penetration rate from 2011 to 2019. The Kleibergen-Paap test was used to conduct a weak instrumental variable test, and the model was estimated on the basis of a fixed effects model in the form of ordinary fixed effects (year + industry) for the combination of instrumental variables and two-way fixed effects (individual + year) for the combination of instrumental variables. The estimation results are shown in Table 7 below:

Tab 7 Results of two-stage least squares estimation (instrumental variables + fixed effects)

Variable	Ordinary fixed effects +IV		Two-way fixed effects +IV	
	Level1	Level2	Level3	Level4
	(1)	(2)	(3)	(4)
	CF*DIFI	Cash	CF*DIFI	Cash
CF*DIFI		-0.0316**		-0.0750***

		(-2.360)		(-2.837)
CF*Inter	2.657***		3.982***	
	(29.44)		(30.371)	
CF	0.271***	0.452***	0.499***	0.644***
	(4.870)	(2.644)	(6.341)	(3.615)
Grow	0.000548	0.0148	-0.00407	0.0165
	(0.165)	(1.567)	(-1.065)	(1.584)
Size	0.322***	0.0294	4.031***	1.625**
	(3.442)	(0.135)	(15.443)	(2.573)
NWC	0.0441 ***	0.102***	0.0136	0.126***
	(4.881)	(3.194)	(1.528)	(3.798)
SD	0.0155*	0.0997** *	0.00379	0.0753***
	(1.926)	(4.150)	(0.437)	(3.026)
Expend	-0.00133	0.0925*	-0.0999***	0.214***
	(-0.0910)	(1.950)	(5.172)	(3.394)
Cons-	-10.34***	1.530	-86.775***	-39.02***
	(-4.918)	(0.293)	(-15.169)	(-2.832)
Individual fixed effects			control	control
Industry fixed effects	control	control		
Year fixed effect	control	control	control	control
N	5865	5865	5865	5865
Adj.R2	0.907	0.095	0.832	0.063
KP rk Wald (Fvalue)	866.54***		984.29***	

Note: Robust T-statistics in parentheses; ****, **, and * represent significant at 1%, 5% and 10% significance levels, respectively.

The estimated coefficient of the instrumental variables intersection term on the digital finance intersection term is 3.982, which is also significant at the 1% level, and the KP RK Wald F-value is also greater than the empirical broad value, indicating that the instrumental variables are effectively chosen and that Internet penetration is highly correlated with digital finance. The first columns (2) and (4) estimate the results for the second stage columns, we focus on the number of financial and corporate cash flows to estimate the coefficients by item, it can be found that when using instrumental variables, digital finance has a significant impact on SME financing constraints, still, verifying the conclusion that digital finance development can alleviate SME financing constraints.

5.3 Robustness Tests

Although the estimation through GMM model in the previous empirical process is also a robustness test to some extent, in order to further for strengthen the robustness of the empirical results of H2.1, this paper re-tests the conclusion that digital finance can

alleviate corporate financing constraints by replacing control variable indicators, proxy variables in digital finance, and digital constraint proxy variables.

5.3.1 Replacing indicators of control variables

In the cash-cash flow sensitivity model constructed by Almeida et al. (2004), Tobin's Q value is used to represent the growth of the firm in the original model to control for the effect of future investment opportunities on the firm's cash holdings. In the robustness testing section of this chapter, the company's Tobin's Q value is used to represent the company's growth capability and is added as a control variable in the regression equation. The representative symbol is Tobinq, and the data source is the Guotai Junan database. The new firm growth index is substituted into the original equation and estimated using a two-way fixed effects model, and the revaluation results are shown in Table 8 below:

Tab 8 Robustness test (1): replace the enterprise growth index

Variable	(1)	(2)	(3)	(4)	(5)
	Cash	Cash	Cash	Cash	Cash
CF	0.496***	0.683***	0.660***	0.705***	0.653***
	(9.925)	(5.273)	(5.588)	(4.940)	(6.036)
CF*DIFI		0.105**			
		(-2.872)			
CF*DIFI_CB			-0.0912**		
			(-2.551)		
CF*DIFI_UD				-0.119***	
				(-3.198)	
CF*DIFI_DL					-0.0887**
					(-2.015)
Tobinq	0.301	0.361	0.350	0.366	0.366
	(1.319)	(1.586)	(1.545)	(1.594)	(1.609)
Size	3.860***	3.975***	3.950***	3.994 ***	3.981***
	(5.963)	(6.199)	(6.137)	(6.280)	(6.188)
NWC	0.0873***	0.0930***	0.0917***	0.0939***	0.0936**
	(2.808)	(2.991)	(2.955)	(3.012)	(3.009)
SD	0.0718***	0.0738***	0.0735***	0.0735***	0.0744***
	(3.092)	(3.188)	(3.172)	(3.178)	(3.215)
Expend	0.123**	0.121*	0.121*	0.121*	0.123**
	(1.996)	(1.958)	(1.951)	(1.962)	(1.987)
Cons-	-87.42***	-89.96***	-89.41 ***	-90.37***	-90.11***
	(-6.221)	(-6.468)	(-6.406)	(-6.549)	(-6.457)
Individualfixedeffects	control	control	control	control	control
Yearfixedeffect	control	control	control	control	control
N	5865	5865	5865	5865	5865

Adj.R2	0.057	0.055	0.062	0.058	0.060
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Note: Robust T-statistics in parentheses; ****, **, and * represent significant at 1%, 5% and 10% significance levels, respectively.

As seen in the table above, there is no significant change in the estimated results in the Tobin's Q value, which represents the ability of firms to grow, and the coefficient of interaction between finance and corporate cash flow in the figures we are interested in remains negative at the 1% or 5% level of significance, including the use of digital finance in depth to alleviate the strongest financing constraints on SMEs. Replacing the control variable indicators validates the robustness of the conclusion that digital finance can alleviate corporate financing constraints.

5.3.2 Financing constraints proxy variable substitution

OLS regression, individual fixed effects regression, and two-way fixed effects regression were used, and the estimation results are shown in Table 9 below:

Tab 9 Robustness check (2): Replace the digital financial proxy variable

Variable	OLS	OLS	Individual fixed effect	Two way fixed effect
	Cash	Cash	Cash	Cash
CF	0.400*** (2.641)	0.443*** (3.002)	0.681*** (3.068)	0.550** (2.540)
CF*Inter	-0.0504** (-2.209)	-0.0840** (-2.360)	-0.298*** (-2.833)	-0.0911** (-2.260)
Grow		0.0148 (1.566)	0.0168 (1.612)	0.00835 (0.785)
Size		0.0192 (0.0888)	1.323*** (3.154)	3.638*** (5.281)
NWC		0.100*** (3.175)	0.125*** (3.773)	0.0886*** (2.770)
SD		0.0992** * (4.127)	0.0750*** (3.002)	0.0679*** (2.781)
Expend		0.0926* (1.952)	0.222*** (3.613)	0.126** (2.045)
Cons-	6.187*** (2.734)	1.857 (0.363)	-32.51*** (-3.499)	-82.07*** (-5.471)
Individual fixed effects			control	control
Industry fixed effects	control	control		
Year fixed effect	control	control		control

N	5865	5865	5865	5865
Adj.R2	0.077	0.075	0.047	0.068

Note: Robust T-statistics in parentheses; ***, **, and * represent significant at 1%, 5% and 10% significance levels, respectively.

It can be concluded that the cash flow sensitivity of SMEs in provinces with higher Internet penetration is weaker, i.e., SMEs have less financing constraints. In contrast, digital finance is more widely and deeply used in regions with higher Internet penetration, and can provide greater financing support for SMEs. The robustness test of replacing the digital finance proxy variables supports the original conclusion, indicating that the conclusion that digital finance can alleviate the financing constraints of SMEs is robust.

5.3.3 Financing constraints proxy variable substitution

In this paper, in addition to the cash-flow sensitivity model to represent the degree of financing constraints, the SA index is also used to represent the financing constraints of firms, and the model is reconstructed for estimation as one of the robustness tests for the conclusions of this chapter.

The robustness test uses the SA index formula designed by Hadlock and Pierce (2010) to calculate the SA index for each SME for the years 2011 - 2019. The absolute value of all SA indices was taken and the result obtained was the degree of financing constraint of SME I in year t. The larger the SA index after the absolute value, the more severe the financing constraint. After selecting the corresponding control variables, the SA model is established as follows:

$$SA_{it} = a_0 + a_1 DIFI_{it} + a_2 Age_{it} + a_3 Size_{it} + a_4 Grow_{it} + a_5 M_B_{it} + a_6 Ln_ass_{it} + a_7 Mshare_{it} + a_8 Audit_{it} + a_9 Dual_{it} + a_{10} Indratio_{it} + Yeardummy + Industrydummy + u_{it} \quad (4.5)$$

The data sources are Wind database and Guotai Junan database, and the regression results are presented below:

Tab 13 Robustness test (3): replace the financing constraint proxy variable

Variable	(1)	(2)	(3)	(4)
	SA	SA	SA	SA
DIFI	-0.0402*** (-3.798)			
CF*DIFI_CB		-0.0428*** (-3.798)		
CF*DIFI_UD			-0.0403** (-3.670)	
CF*DIFI_DL				-0.0339** (-2.420)
Age	-0.0155 (-1.531)	-0.0138 (-1.416)	-0.0160 (-1.480)	-0.0159 (-1.578)
Size	0.0288*** (5.607)	0.0290*** (5.662)	0.0285*** (5.585)	0.0285*** (5.579)

Grow	0.0105***	0.0107***	0.0105***	0.0105***
	(4.081)	(4.172)	(4.086)	(4.092)
M_B	-0.00226**	-0.00221**	-0.00230**	-0.00231**
	(-2.296)	(-2.252)	(-2.336)	(-2.350)
In_ass	-0.0510	-0.0522	-0.0519	-0.0524
	(-0.984)	(-1.009)	(-1.000)	(-1.009)
Mshare	-0.0150	-0.0145	-0.0154	-0.0153
	(-0.987)	(-0.956)	(-1.008)	(-1.006)
Audit	-0.0501**	-0.0499**	-0.0499**	-0.0498**
	(-2.116)	(-2.121)	(-2.104)	(-2.103)
Dual	5.39e-06	-0.000129	6.94e-05	3.37e-05
	(0.00183)	(-0.0441)	(0.0237)	(0.0115)
Indratio	-0.000350	6.74e-06	-0.00113	-0.00176
	(-0.0144)	(0.000281)	(-0.0468)	(-0.0730)
Cons-	2.418**	2.429***	2.270***	2.271***
	(19.50)	(21.41)	(20.55)	(18.93)
Individual fixed effects	control	control	control	control
Year fixed effect	control	control	control	control
N	5865	5865	5865	5865
Adj.R2	0.927	0.905	0.887	0.868

Note: Robust T-statistics in parentheses; ***, **, and * represent significant at 1%, 5% and 10% significance levels, respectively.

From the above table, it is clear that digital finance and its sub-indices have a significant negative impact on the financing constraints of enterprises. Based on the estimation results of the SA index model, the following conclusions can be drawn more intuitively: The development of digital finance in the region can significantly alleviate the level of financing constraints of urban SMEs, and the contribution of all dimensions of digital finance development to financing support is significant. Robustness tests with the SA model as the main regression support the robustness of the previous findings.

5.4 Heterogeneity Analysis

5.4.1 Nature of ownership: state-owned, private and foreign-funded enterprises

To further examine which nature of SME financing constraints are more alleviated by digital finance and to verify H2.2a, this section conducts a cluster test based on the classification of firm nature provided by Wind database, depending on the sample type, to investigate whether the degree of alleviation of financing constraints is the same for different types of firms.

Tab 11 Alleviating effect of digital finance on financing constraints of small and medium-sized

enterprises under different ownership

Variable	State-owned enterprises	Private enterprise
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	Cash	Cash	Cash	Cash
CF	0.297***	0.446***	0.488***	0.660***
	(7.396)	(4.617)	(13.37)	(8.127)
CF*DIFI		-0.0831		-0.0960**
		(-1.213)		(-2.373)
Grow	-0.00684	-0.00769	0.0123	0.0122
	(-0.403)	(-0.453)	(1.252)	(1.237)
Size	3.218**	3.094**	3.796***	3.897***
	(2.546)	(2.441)	(5.670)	(5.812)
NWC	0.0962**	0.102**	0.0722***	0.0784***
	(2.109)	(2.219)	(2.968)	(3.205)
SD	0.118**	0.118***	0.0512**	0.0540***
	(3.582)	(3.607)	(2.526)	(2.661)
Expend	-0.0221	-0.0270	0.154***	0.153***
	(-0.277)	(-0.339)	(3.305)	(3.299)
Cons-	-72.39***	-69.60**	-85.40***	-87.53***
	(-2.595)	(-2.488)	(-5.879)	(-6.017)
Individual fixed effects	control	control	control	control
Year fixed effect	control	control	control	control
N	1251	1251	4509	4509
Adj.R2	0.047	0.025	0.034	0.118

Note: Robust T-statistics in parentheses; ***, **, and * represent significant at 1%, 5% and 10% significance levels, respectively.

From the results of the point sample test, the alleviation of financing constraints of SMEs by digital finance is better in private enterprises, and the coefficient of interaction between finance and cash flow of private enterprises in the sub-sample number is 0.096 and significant at the 5% level, indicating that the development of digital finance has a significant alleviating effect on the financing constraints of private SMEs. In contrast, the absolute value of the coefficient of state-owned enterprises is slightly smaller than that of private enterprises, but it is not significant, indicating that the alleviation of financing constraints of state-owned SMEs by digital finance is not significant, and the conclusion supports hypothesis 2.2a

5.4.2 Regional attribute: China's eastern, central and western regions

This paper continues to examine whether there is heterogeneity in the financing constraints of digital finance for SMEs across regions to verify H2.2b. In this section, the sample enterprises are divided into subsamples of eastern, central and western regions according to their locations, and the model regressions are estimated separately to obtain the estimation results of the subsamples.

Tab 12 Alleviating effect of digital finance on financing constraints of smes in different regions

of economic development

Variable	Eastern region		Central region		Western region	
	Cash	Cash	Cash	Cash	Cash	Cash
CF	0.500***	0.761***	0.417** *	0.326*	0.690** *	0.735** *
	(14.09)	(9.200)	(4.602)	(1.887)	(6.781)	(3.942)
CF*DIFI		- 0.141***		0.0568		-0.0296
		(-3.494)		(0.621)		(-0.286)
Grow	0.0109	0.0105	-0.00733	- 0.00741	0.00899	0.00913
	(1.118)	(1.087)	(-0.306)	(-0.310)	(0.382)	(0.388)
Size	3.303***	3.418***	5.254** *	5.173** *	4.578** *	4.556** *
	(5.062)	(5.238)	(2.929)	(2.874)	(2.670)	(2.652)
NWC	0.0678** *	0.0761 ***	0.0760	0.0716	0.302** *	0.303** *
	(2.890)	(3.234)	(1.230)	(1.150)	(4.285)	(4.290)
SD	0.0723** *	0.0756** *	-0.00517	- 0.00489	0.120** *	0.122** *
	(3.695)	(3.862)	(-0.101)	(- 0.0958)	(2.660)	(2.673)
Expend	0.0712	0.0704	0.516** *	0.519** *	0.0687	0.0670
	(1.575)	(1.559)	(4.330)	(4.349)	(0.631)	(0.614)
Cons-	- 74.37***	- 76.78***	- 118.6** *	- 116.9**	- 105.1** *	- 104.6** *
	(-5.240)	(-5.411)	(-3.035)	(-2.982)	(-2.800)	(-2.780)
Individual fixed effects	control	control	control	control	control	control
Year fixed effect	control	control	control	control	control	control
N	4554	4554	828	828	585	585
Adj.R2	0.038	0.045	0.064	0.022	0.012	0.033

Note: Robust T-statistics in parentheses; ****, **, and * represent significant at 1%, 5% and 10% significance levels, respectively.

The development of digital finance in eastern China significantly alleviates the financing constraints of SMEs listed on the SME board, while the development of digital finance in central and western China has no significant alleviating effect. The findings negate hypothesis 2.2b, which suggests that digital finance plays an "icing on the cake" in alleviating financing constraints for listed SMEs.

5.4.3 Nature of innovation: whether it is a high-tech enterprise

To verify H2.2c and examine the heterogeneous impact of digital finance on financing constraints of SMEs with different industry properties, this paper uses listed companies classified as C27, C39, I, and M by the SEC as innovative enterprises, and distinguishes high-tech and non-high-tech enterprises according to this criterion to form two samples for regression analysis, and estimates the results through a two-way fixed-effects model regression as follows:

Tab 13 Alleviating effect of digital finance on financing constraints of high-tech enterprises

Variable	High-tech enterprises		Non-high-tech enterprises	
	Cash	Cash	Cash	Cash
CF	0.632**	0.889***	0.448***	0.598***
	(9.635)	(6.029)	(12.54)	(7.663)
CF*DIFI		-0.114**		-0.0839**
		(-2.047)		(-2.164)
Grow	0.0216	0.0219	0.000189	-0.000196
	(1.338)	(1.357)	(0.0190)	(-0.0197)
Size	2.805**	2.877**	3.845***	3.909***
	(2.493)	(2.558)	(5.613)	(5.704)
NWC	0.118***	0.124***	0.0703***	0.0763***
	(2.907)	(3.044)	(2.873)	(3.102)
SD	0.0688*	0.0706**	0.0643***	0.0664***
	(1.954)	(2.006)	(3.319)	(3.426)
Expend	-0.000990	-0.00451	0.174***	0.173***
	(-0.0121)	(-0.0550)	(3.868)	(3.842)
Cons-	-63.81***	-65.26***	-86.63***	-87.97***
	(-2.616)	(-2.677)	(-5.801)	(-5.888)
Individual fixed effects	control	control	control	control
Year fixed effect	control	control	control	control
N	1245	1245	3826	3526
Adj.R2	0.027	0.035	0.016	0.053

Note: Robust T-statistics in parentheses; ***, **, and * represent significant at 1%, 5% and 10% significance levels, respectively.

Regression analysis shows that financing constraints are indeed stronger for high-tech firms than for non-high-tech firms. The estimated coefficient of cash flow in column (1) is 0.632, which is larger than 0.448 in column (3), and both are significant at the 1% level. The absolute value of the digital finance cash flow interaction coefficient in column (2) (-0.114) is also larger than that of non-high-tech enterprises (-0.0839), indicating that high-tech enterprises are more strongly influenced by digital finance than non-high-tech enterprises in terms of alleviating financing constraints. The findings support hypothesis

2.2C in this chapter, which states that digital finance has a stronger effect on mitigating financing constraints for high-tech firms than for non-high-tech firms.

6 Conclusions and Policy Recommendations

This paper empirically tests the digital finance effect with the data of listed companies in the SMB as the research sample, and adopts various econometric models such as two-way fixed effect model, systematic GMM model, instrumental variable method, and other econometric models for SME financing constraints, and considers the heterogeneity of enterprise ownership, regional heterogeneity, and the influence of innovation attributes, etc. Based on this empirical study, the following conclusions are finally drawn.

SMEs have a relatively single financing channel and rely heavily on financing from banks and other institutions. Through heterogeneity analysis and empirical analysis, it is concluded that digital finance can alleviate SME financing constraints and its heterogeneous effects. First, digital finance has a significant role in alleviating SME financing constraints both in listed and unlisted enterprises; second, the impact of digital finance on SME financing constraints is geographically heterogeneous, with different levels of economic development in the eastern, central and western regions on SME. The impact of digital finance on SMEs' financing constraints is different; third, the effect of digital finance on SMEs' financing constraints alleviation is heterogeneous in terms of the nature of corporate innovation, which can better play a role in financing constraints alleviation for high-tech SMEs. The above results indicate that digital finance has a significant mitigating effect on the financing constraints of SMEs.

The findings of this paper have the following policy implications. First, reasonably open government department data, strengthen the construction of social credit system, and solve the problem of information asymmetry between banks and enterprises. Second, increase the investment in digital "new infrastructure". On the one hand, maintaining the foundation of digital finance development and encouraging SMEs to "go to the cloud", "develop information technology" and "industrial Internet" are important measures to realize information technology on the demand side of digital finance. On the other hand, the policy should be based on the concept of "cloud", "development of information technology" and "industrial internet". On the other hand, policies should be guided by the "new infrastructure", and policy measures should be implemented to encourage the continuous construction of digital infrastructure and the rapid development of digital transformation of financial institutions and enterprises in less developed regions. Third, digital regulation should be used to address the risks of digital finance and optimize the financial market environment. Regulators should improve the regulatory mechanism, avoid regulatory gaps, clarify the division of labor and strictly implement regulatory policies. Fourth, promote the development of digital and financial integration and improve the digital financial ecosystem. Fifth, improve the financial literacy of SMEs and actively embrace digital finance in order to improve the financing constraints of SMEs.

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