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

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Abstract: *Small and medium-sized enterprises (SMEs) generally face the problem of financing constraints, and the emergence of digital finance provides new ideas to alleviate financing constraints. This paper empirically analyzes the financial data of listed companies in ChiNext and STAR Market from 2012 to 2021, and finds that: Chinese SMEs do face the problem of financing constraints, and the emergence of digital inclusive finance has a certain mitigating effect on SMEs' financing constraints, but there is more room for its enhancement. In view of the above conclusions, this paper puts forward relevant suggestions, with a view to better solving the financing constraints faced by SMEs and promoting the vigorous development of SMEs.*

Keywords: *Digital Finance, Financing Constraints, SMEs*

1. Introduction

Financing constraints not only cause obstacles to the business activities of enterprises[1], but also limit the investment in innovation[2][3][4], which is a key problem restricting the development of enterprises[5][6], and one of the important bottlenecks for economic transformation and upgrading [7]. With the continuous breakthroughs in artificial intelligence technology and applications represented by big data, cloud computing and big models, digital inclusive finance has gradually come into people's view, digital inclusive finance through digital technology for the financial exclusion of small and medium-sized enterprises to provide relatively equal financing opportunities, reduce the information asymmetry caused by the high risk premium and the high cost of financing, and guide the resources and funds tilted to the relatively disadvantaged small and medium-sized enterprises. So, can the development of digital finance effectively alleviate the financing constraints of SMEs?

This is a very important and worthwhile issue, and there are currently different views in the academic field[8][9]. To explore the relationship between digital finance and financing constraints of SMEs, this study proposes some hypotheses to test and get some remarkable conclusions.

The following structure of this paper is as follows: The second part is the theoretical mechanism and research hypothesis. The third part is research design, including data source, variable selection and econometric model construction. The fourth part is the analysis of test results. The fifth part is conclusion.

2. Hypothesis Development

From the point of view of the impact of external factors, due to the information asymmetry between the supply side of funds and SMEs, financial institutions have to invest more human and material costs in their information collection, and they can not get complete and true information about the enterprise, and they can not accurately assess the credit level of the enterprise, so the enterprise has to pay more than the cost of obtaining external financing, which makes it difficult for the enterprise to obtain external financing. This makes it difficult for enterprises to obtain external financing[10][11].

From the perspective of the influence of internal factors, SMEs are unable to effectively show their credit quality due to their lesser assets and insufficient collaterals, thus causing their financing difficulties[12]. And due to the lack of long-term strategic support for the operation of SMEs, it leads to the problem of short survival cycle and poor ability of continuous operation, coupled with the vicious competition among SMEs caused by the capital market disorder, which makes the difficulty of

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financing SMEs intensified[13]. There are also studies that show that SMEs are prone to the problem of capital shortage, and in the face of good opportunities for market development, the available funds are difficult to turnover, and if they want to seize the opportunities, they are forced to borrow from banks at higher interest rates, which makes the cost of financing too high[14].Based on this, this paper proposes the following hypotheses:

H1: SMEs have financing constraints.

There has been a good deal of literature examining the relationship between digital financial inclusion and corporate finance constraints, and the views have not yet been harmonized[15][16][17].On the one hand, the rapid development of digital financial inclusion has overcome the problems of financial disincentives, credit discrimination and resource mismatch under traditional finance, and has significantly increased the penetration and popularization of financial services. On the other hand, the development of digital finance can help banks to obtain more SME business information at a lower cost, significantly reduce the level of information asymmetry between banks and enterprises, and alleviate SME financing problems to bring a major breakthrough[18][19][20].Based on this, this paper proposes the following hypotheses:

H2: Digital finance can alleviate SME financing constraints, in particular, coverage, usage and digitization can alleviate SME financing constraints.

3. Research Design

3.1. Sample Selection and Data Sources

For the convenience of research, the listed companies on the ChiNext and STAR Market from 2012 to 2021 are selected as the research samples in this paper. The data of SMEs are from the CSMAR database, and the digital finance indicators are from the Peking University Digital Inclusive Finance Index published on the official website of Peking University Digital Finance Research Center. In addition, in order to ensure the continuity and validity of the data, and the sample is processed as follows:(1) Excluding ST and *ST companies to ensure the reliability of financial data;(2) Excluding samples with missing values to ensure the continuity of the sample data. The short panel data containing 90 individual SMEs, a 10-year time span, and a total sample size of 900 are finally established as the research object of this paper.

3.2. Variables Selection

3.2.1. Explained Variable: ΔCash

The dependent variable in this study is changes in cash and cash equivalents held by the enterprise (ΔCash). SMEs facing financing constraints will hold more cash flow, SMEs without financing constraints will hold less cash flow. Therefore, the change of the cash flow held by the enterprise can reflect the degree of financing constraints faced by the enterprise.

3.2.2. Explanatory Variables

This article has two kinds of explanatory variables: CF indicates the cash flow and interaction terms for CF and DF where DF indicates the digital financial index. DF can be further divided into DF_1, DF_2 and DF_3, which respectively indicate Coverage, Usage and Digitization of digital finance. If the cash and cash equivalents held by the enterprise are negatively correlated with the net increase of cash flow generated by the business activities, it means that the holding of cash and cash equivalents should not be obtained from the cash flow, that is, the enterprise can obtain funds from outside without any financing constraints; otherwise, it indicates that the external financing of the enterprise has constraints.

3.2.3. Control Variables

Referring to previous studies[21][22], the control variables we have selected are listed in Table 1, along with their detailed definitions document.

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Table 1: Definition of variables

Type of variable	Variable name	Variable symbol	Definition
Explained variable	Changes in cash and cash equivalents	ΔCash	See previous variable description
Explanatory variable	Cash flow	CF	Cash flow
	Index*Cash flow	DF*CF	The product of the DF Index and cash flow
	Coverage* Cash flow	DF_1*CF	The product of Coverage and cash flow
	Usage*Cash flow	DF_2*CF	The product of Usage and cash flow
	Digitization*Cash flow	DF_3*CF	The product of Digitization and cash flow
Controlled variable	Changes in assets	InSize	Logarithm of the total assets
	TobinQ	Tobinq	Total market capitalization at the end of the period/total assets at the end of the period
	Capital Expenditure	Capex	Cash outlays for acquisition of property, plant and equipment, intangible assets and other long-term assets /total assets at the beginning of the period
	Changes in net working capital	ΔNWC	Increase in net working capital /total assets at the beginning of the period
	Changes in short-term liabilities	ΔSTD	Increase in current liabilities/total assets at the beginning of the period

3.3. Model Specification

Almeida was the first to introduce the cash-cash flow sensitivity model in 2004[23], and Lian Yujun et al. conducted an empirical analysis through the data of domestic enterprises, and found that this model is also applicable in China[24], which can be used to study the financing constraints of enterprises. Therefore, we refers to this model for research, and the benchmark model is as follows:

$$\Delta Cash_{it} = \alpha_0 + \alpha_1 CF_{it} + \alpha_2 \ln Size_{it} + \alpha_3 Tobinq_{it} + \alpha_4 Capex_{it} + \alpha_5 \Delta NWC_{it} + \alpha_6 \Delta STD_{it} + \gamma_i + \delta_i + \varepsilon_{it} \quad (1)$$

$$\Delta Cash_{it} = \beta_0 + \beta_1 CF_{it} + \beta_2 DF_{it} * CF_{it} + \beta_3 \ln Size_{it} + \beta_4 Tobinq_{it} + \beta_5 Capex_{it} + \beta_6 \Delta NWC_{it} + \beta_7 \Delta STD_{it} + \gamma_i + \delta_i + \varepsilon_{it} \quad (2)$$

where γ_i, δ_i are dummy variables reflecting the individual effect and the time effect, respectively, and ε_{it} is the error term.

4. Empirical Results and Analysis

4.1. Sample Descriptive Statistics

Table 2 reports the results of descriptive statistics of the main variables.

Table 2: Descriptive statistics

Variable	N	Max	Min	Mean	SD
ΔCash	900	1.564	-0.474	0.007	0.133
CF	900	1.021	-0.309	0.054	0.091
DF	900	359.683	74.19	235.495	65.729
DF1	900	371.79	67.91	236.969	64.402
DF2	900	354.305	58.74	230.388	69.869
DF3	900	340.008	72.54	239.918	75.381
lnSize	900	25.944	20.008	21.789	0.923
Tobinq	900	16.896	0.837	2.576	1.577
Capex	900	0.423	0.0003	0.058	0.058
ΔNWC	900	1.702	-0.395	0.412	0.252
ΔSTD	900	2.432	0.012	0.305	0.211

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As can be seen from the table, the minimum value of ΔCash is -0.474 while the maximum value is 1.564, which shows opposite signs, i.e., some SMEs increase their existing cash-based assets for various motives while some SMEs decrease their cash-based assets for various motives. The standard deviation of 0.133 shows that the change in cash-based asset holdings varies considerably across SMEs. On average, SMEs' cash flows mainly change positively, i.e., they are more willing to increase their existing cash-based assets such as cash and cash equivalents.

In terms of the explanatory variable CF, relative to ΔCash, although the maximum and minimum values of the two variables show both positive and negative cases, the standard deviation of CF is only 0.091, and the ratio of its standard deviation to the mean is only 1.69, which makes the data relatively less discrete, i.e., most SMEs' cash from operating activities situation is relatively stable. On the other hand, on average, most SMEs have positive changes in cash flow from operating activities.

From the explanatory variables digital finance indicators including DF, DF1, DF2, DF3, the ratio of the maximum and minimum values of the four variables is 5.26 times on average, which indicates that there are obvious differences in the digital financial environment of different SMEs due to the differences in the financial infrastructure and digital technology facilities of the regions in which they are located and manifested by the existence of large differences in various indicators related to digital finance of different SMEs.

In terms of other continuous variables, the maximum and minimum ratios of lnSize, Tobinq, and Capex are 1.09, 3.08, and 193.34 in that order, reflecting the fact that although the degree of difference in the size of the SMEs in the sample is not very large, the differences in market capitalization and capital expenditures among different firms are more obvious.

4.2. Regression analysis

4.2.1. Correlation Test

In order to avoid the existence of multicollinearity between the variables and other problems that lead to the bias of the measurement model, this paper used the Pearson correlation coefficient to correlate the explanatory variables in the model, and the results are presented in Table 3.

Table 3: Pearson's correlation coefficient table

	CF	DF	lnSize	Tobinq	Capex	ΔNWC	ΔSTD
CF	1						
DF	0.084**	1					
lnSize	0.121***	0.471***	1				
Tobinq	0.338***	0.042	-0.036	1			
Capex	0.105***	-0.2***	0.081**	0.063*	1		
ΔNWC	0.139***	-0.303***	-0.338***	0.099***	-0.087***	1	
ΔSTD	0.071**	0.183***	0.498***	0.043	0.068**	-0.343***	1

Note: *, ** and *** represent significant at the level of 10%, 5% and 1% respectively

As can be seen from the table, the correlation coefficients are basically below 0.5, which means that most of the variables are not strongly correlated.

4.2.2. Model Selection

For panel data, common regression analyses are mixed regression, fixed effects and random effects models. In this paper, the Hausman test is used to select the model, and the results are shown in Table 4.

Table 4: Hausman Test

Type	Statistic	Prob.
Hausman Test	13.983	0.000***

Note: *, ** and *** represent significant at the level of 10%, 5% and 1% respectively

From the table, it can be seen that the P-value is 0.000, which means that the hypothesis of insignificant difference in the estimators of the fixed-effects model is rejected at the 1% significance level, indicating that the choice of analyzing the data using the fixed-effect model is more reasonable.

4.2.3. Empirical Results

This study uses the fixed effect model to analyze and the empirical results are shown in Table 5. In

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order to find out whether SMEs have financing constraints problem model, we regress the model (1) and the results are shown in the first column. To verify whether digital finance can alleviate the financing of SMEs, we add the interaction terms DF*DF, DF1*CF, DF2*CF, DF3*CF to the model in turn, and the empirical results are listed in column 2 to column 5.

Table 5: Empirical Results

	(1)	(2)	(3)	(4)	(5)
CF	0.4440***	0.5103***	0.5125***	0.5056***	0.5107***
DF*CF		-6.43e-14***			
DF1*CF			-6.64e-14***		
DF2*CF				-5.98e-14***	
DF3*CF					-6.41e-14***
lnSize	0.0380***	0.0475***	0.0478***	0.0467***	0.0478***
Tobinq	0.0005	0.0006	0.0007	0.0006	0.0007
Capex	-0.2997***	-0.2886***	-0.2877***	-0.2898***	-0.2893***
ΔNWC	0.2200***	0.2179***	0.2182***	0.2177***	0.2175***
ΔSTD	0.3753***	0.3673***	0.3673***	0.3679***	0.3663***
Constant	-1.0337	-1.2376	-1.2444	-1.2196	-1.2447
R^2	0.2225	0.2320	0.2324	0.2310	0.2323
Individual Fixed	Control	Control	Control	Control	Control
Time Fixed	Control	Control	Control	Control	Control

From the coefficients of the explanatory variables, the coefficient of CF is positive at 1% level of significance, i.e., an increase in cash flow of SMEs leads to the retention of more internal cash assets to alleviate the problem of external financing constraints. Therefore, that is, it confirms the validity of hypothesis 1 that SMEs generally have financing constraints. The size of the coefficient on CF reflects the fact that, at the 1% significance level, a one-unit increase in cash flow from operating activities is associated with an increase in the retention of cash-based assets within the enterprise of between 0.44 and 0.51 units, i.e., SMEs are more severely constrained by financing.

The coefficients of columns (2) to (5) show that after the introduction of the interaction term of digital finance-related variables with CF, the coefficients of each interaction term are negative at the 1% significance level, i.e., it indicates that the digital finance and coverage, usage, and digitization of the digital finance can alleviate the problem of SMEs' financing constraints, which confirms Hypothesis 2. The coefficient of the interaction term between the digital finance-related variables and CF is extremely small, indicating that although digital finance has alleviated the financing constraints of SMEs to a certain extent, there is still much room for improvement in the alleviation effect.

5. Conclusions

This paper examines the relationship between digital finance and financing constraints of SMEs using the data of listed companies in ChiNext and STAR Market from 2012 to 2021. The empirical results show that: (1) Chinese SMEs do face the problem of financing constraints. (2) The emergence of digital finance has a certain mitigating effect on SMEs' financing constraints, but there is more room for its enhancement.

The above findings have important implications for how to achieve better and faster development under the background of digital financial development. This paper provides new empirical evidence for the study of digital finance and financing constraints, which can provide policy recommendations for government departments and enterprises.

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