

# The Development of Digital Finance and Financing Constraints of Small and Medium-sized Enterprises

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**Abstract.** As a part of the national economy, Small and Medium-sized enterprises play a role in promoting a country's economy, but most studies show that financing constraints hinder the innovation and development of small and Medium-sized enterprises. This paper analyzed the effect of descriptive statistics, robustness test, and heterogeneity analysis to explore the impact of digital financial development on small and Medium-sized enterprises' financing constraints. Research shows that with the increase of the digital finance index, financing constraint tends to decrease. Therefore, the development of digital finance plays a positive role in the financing constraints of small and Medium-sized enterprises.

**Keywords:** Digital Finance; Financing Constraint; Small and Medium-sized Enterprises.

## 1. Introduction

Digital finance refers to a new financial business model in traditional financial institutions, and Internet companies use digital technology to achieve financing, payment, and investment. As an important part of the national economy, the development of SMEs plays an important role in promoting innovation, promoting employment, and stabilizing the economy. With the progress of the times, the digital financial system has also provided great help for corporate borrowing. Generally, larger companies have easier access to credit support from traditional financial institutions, but SMEs often face credit rationing. Therefore, digital finance provides credit funds for SMEs in the credit market through digital commercial credit evaluation methods such as big data, thus easing the financing constraints of SMEs. Digital finance mainly provides credit support for the long-tail market dominated by SMEs, helping alleviate "ownership discrimination" and "scale discrimination" in the credit market and improving the efficiency of financial resource allocation.

The reform and development of China's digital finance have been developing for more than 30 years. The first watershed was the emergence of Alipay in 2003. In 2003, the birth of Alipay played an important role in the development of digital finance. Before 2003, most of China's digital finance was the financial industry, and the financial industry did not change its business process and business model. While Alipay is not the world's first online payment application, its success is closely related to China's current business model. Taobao builds an online trading platform for merchants and consumers and establishes a trust relationship with consumers through Alipay to improve trading volume as a credit intermediary. In 2013, the emergence of WeChat Pay changed the pattern of mobile payment, and the vast majority of Chinese people began to use Alipay and WeChat as means of payment. These two important payment tools have strongly promoted the internet's entry into the financial industry. With the development of Internet enterprises, digital financial services such as payment, credit, insurance, credit, investment, and money fund have begun to take root and sprout in China's financial system and rapidly spread to all financial fields.

According to the Digital Financial Inclusion Index data from 2011 to 2018, as shown in Table 1, digital financial inclusion has made great progress in all provinces and cities of China since 2011.

Take Jiangsu Province of China as an example. As shown in Table 1 below, taking Zhejiang province and Guizhou Province of China as examples, the Index Aggregate of Zhejiang Province, as an economically developed province, increased from 77.39 to 357.45, with an increase of 361.8%. Guizhou province is relatively backward economically; the inclusive index increased from 18.47 to 276.91, indicating a high degree of popularity of digital finance.

**Table 1.** Digital financial index

Year	Province	Digital Finance Index
<b>Province: Zhejiang</b>		
2011	Zhejiang	77.39
2012	Zhejiang	146.35
2013	Zhejiang	205.77
2014	Zhejiang	224.45
2015	Zhejiang	264.85
2016	Zhejiang	268.10
2017	Zhejiang	318.05
2018	Zhejiang	357.45
<b>Province: Guizhou</b>		
2011	Guizhou	18.47
2012	Guizhou	75.87
2013	Guizhou	121.22
2014	Guizhou	154.62
2015	Guizhou	193.29
2016	Guizhou	209.45
2017	Guizhou	251.46
2018	Guizhou	276.91

China's digital financial development is currently dominating the world. Such as Alipay, JD.com, Lianyi Rong, Zhong 'insurance, peer-to-peer lending, et al., are leading at the development level. Zavolokina's research in 2015 shows that digital finance has greatly expanded the scale of information acquisition through big data cloud computing and the internet, especially through the internet and automatic information processing system, which has enhanced the availability of finance [1]. This emerging business model promotes the diversification of external financing by optimizing the external financing environment, which can improve flexibility, efficiency, and financing opportunities. In this process, the "28 Laws" of the traditional banking industry are broken by the inclusive characteristics of digital finance and the "long tail effect", and the ability of financial services to reach SMEs is rapidly improved [2]. In their 2018 research, Wei Zou and Jianghuai Ling compared the relationship between traditional inclusive finance and Digital inclusive finance and the financing constraints of SMEs. The results show that developing inclusive finance is an important way to ease the financing constraints of SMEs. At the same time, the economic level and legal environment are important factors that restrict Inclusive Financing to ease the financing constraints of SMEs [3]. The research of Jiayu Wan in 2020 shows that digital finance enriches the sources of capital, increases the amount of financing, and brings significant innovation incentive effects for SMEs [4]. Xuanli Xie believes that the information asymmetry in the financial market has raised the financing cost of SMEs, and digital finance can ease the financing constraint of SMEs by reducing the financing cost [5]. Research by Agarwal and Hauswald shows that compared with the traditional financing model, the financing model featuring network financing is relatively loose in credit review, which lowers the financing threshold for SMEs [6]. Duarte et al. believed in the 2012 research that digital finance uses big data analysis to analyze and evaluate the credit of SMEs by using the business records and transaction behaviors accumulated and deposited by fund demanders on the internet platform [7]. Okiro found through a sample survey in 2016 that the backwardness of digital financial platforms and related technologies hindered digital finance's mitigation effect on SMEs' financing constraints. He believes that digitalization increases the information collection of financial service

providers for SMEs, thus increasing the possibility for SMEs to obtain credit in the future [8]. Shahrokhi's research shows that the financing model based on Internet technology has surpassed direct financing and indirect financing, and has great advantages in easing the financing constraints of SMEs, thus improving the financing efficiency of SMEs [9].

In general, the vigorous development of digital finance in China has an inseparable impact on SMEs. This paper aims to study the relationship between the development of digital finance and the financing constraints of SMEs through the data analysis and modeling of SMEs from 2011 to 2018 to seek the best way to help SMEs develop smoothly and vigorously in financing.

The following parts of the paper are organized as follows: Section 2 is the research design; Section 3 contains empirical results; Section 4 contains the robustness test; Section 5 is the heterogeneity analysis; and section 6 is our conclusion.

## 2. Research Design

### 2.1 Data Sources

The data in this paper are from the Digital Financial Inclusion Index compiled by Peking University and the data of companies in the small and Medium-sized sectors starting with the stock code 002 from 2011 to 2018. This index includes digital financial inclusion index, digital financial coverage, digital financial use depth, and digital financial inclusion degree; In addition, the use of depth index also includes payment, credit, insurance, credit, investment, money funds, and other business sub-indexes. The index covers 31 provinces, 337 prefecture-level cities, and 2,800 counties in mainland China.

The enterprise data comes from the CSMAR database. The CSMAR economic and financial research database is the professional standard of Chicago CRSP, STANDARD & Poor's Compustat, New York Exchange TAQ, I/B/E/S, Thomson, and other international well-known databases. In addition, the economic and financial database was developed using China's current national conditions. The data includes various indicators such as assets, liabilities, and profits of enterprises in detail, clearly and accurately showing each enterprise's operating conditions.

As for sample selection, this paper selects listed companies on the small and Medium-sized board. To remove extreme data, all data in this paper are excluded from the samples of companies in the financial industry, companies by ST and \*ST, and the samples with missing values in variables. Subsequently, the main continuous variables were subjected to 1% winsorize process. As the research purpose of this paper is to explore the relationship between the development of digital finance and China's SMEs, the data of Listed SMEs in China are selected as the research data [10].

### 2.2 Model Specification

Discuss the influence of the development of digital finance on the financing constraints of SMEs., the following model is established in this paper:

$$\text{Financing Constraint}_{it} = \alpha_0 + \alpha_1 \text{Digital Finance}_{it} + \mathbf{x}'_{it}\boldsymbol{\beta} + \varepsilon_{it} \quad (1)$$

Where the *Financing Constraint*<sub>it</sub> is the dependent variable, which is defined as cash generated from operating activities divided by total assets. *Digital Finance*<sub>it</sub> is the core independent variable, that is, the development level of digital finance;  $\mathbf{x}'_{it}$  represents a series of control variables. The variable definition is shown below.

**Aggregate Index:** This paper uses the digital financial Inclusion index developed by the Digital Finance Research Center of Peking University to describe the development of digital finance. The index is compiled based on the big data of Ant Finance trading accounts, which is reliable. This paper uses the aggregate digital finance index to measure the level of digital finance.

**Age:** The age variable used in this paper is derived from the data year - listing year to explore whether Age has a positive or negative influence on the development of digital finance.

Ln asset: This variable takes the logarithm of the total assets of the enterprise.

Ln debt: This variable takes a logarithmic approach to the total liabilities of the enterprise.

Top1: It refers to the shareholding ratio of the largest shareholder.

SOE: State-owned enterprises =1, otherwise =0.

Foreign: Foreign enterprise =1, otherwise =0.

Board Size: It refers to the size of the board of directors.

No. of Independent Director: It refers to the number of independent directors of a company to explore its impact on the development of corporate financial figures.

Ln salary: It refers to the compensation of corporate executives and takes the logarithm of it.

ROA: It refers to the net operating profit rate of an enterprise, and it is the ratio of current net profit to total assets at the end of the period.

### 2.3 Descriptive Statistical Analysis

As shown from Table 2, there is a big difference between the maximum and minimum value of the financing constraint index, with an average of only 4.2412, indicating a big difference in the difficulty of financing constraints for different enterprises. The maximum number of board members is 15, and the average is 8.3958, proving that most small and Medium-sized listed enterprises have little difference in size. The maximum value of ROA is 0.2342, the minimum value is -.3281, and the average value is positive. There is a large gap between the maximum and a minimum number of shares held by the first shareholder, with an average of 32.2534.

**Table 2.** Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Finance Constraint	5096	4.2412	7.0518	-67.0225	43.3593
Aggregate Index	5096	191.2465	64.1703	28.98	302.9827
Age	5096	5.1517	3.2723	0	14
Age-sq	5096	37.2459	38.8556	0	196
Ln asset	5096	21.7878	.953	19.0444	26.1516
Ln debt	5096	20.6334	1.3618	17.4067	25.9776
top1	5096	34.2534	14.6142	4.15	88.92
SOE=1	5096	.1648	.3711	0	1
Foreign=1	5096	.0555	.229	0	1
Board Size	5096	8.3958	1.461	5	15
No. of Independent Director	5096	3.0983	.4637	2	5
Ln salary	5096	14.7773	.7373	11.9685	16.9982
ROA	5096	.0471	.0626	-.3281	.2342

Note: Obs, Mean, St.d. Dev, Min, and Max represent the observation, average value, standard deviation, minimum value, and maximum value in this table.

### 3. Empirical Results

The Pooled OLS is employed in the whole sample using Stata16 software, and the benchmark model is estimated. The estimated summary results are shown in Table 3. The results show that the regression coefficients of the Aggregate Index in the benchmark model are all significantly negative, and the development of inclusive digital finance is helpful to ease the financing constraints of SMEs.

As far as the regression result (2) is concerned, the regression coefficient of the Aggregate Index (AI) is significantly negative at the level of 5%, indicating that with the increase of the digital financial index, the financing constraint tends to decrease.

**Table 3.** Benchmark regression

	(1)	(2)
	Pooled OLS	Pooled OLS
VARIABLES	Finance Constraint	Finance Constraint
Aggregate Index	-0.0004 (0.0050)	-0.0099** (0.0048)
Age		0.6035*** (0.1024)
Age-sq		-0.0261*** (0.0082)
Ln asset		-0.0671 (0.2549)
Ln debt		-0.5656*** (0.1700)
top1		0.0218*** (0.0069)
SOE=1		0.9118*** (0.2559)
Foreign=1		1.5016*** (0.3942)
Board Size		-0.0276 (0.0885)
No. of Independent Director		0.1563 (0.2722)
Ln salary		0.9027*** (0.1685)
ROA		41.7979*** (2.2999)
Constant	3.1396*** (0.5614)	-2.0843 (2.9119)
Observations	5,096	5,096
R-squared	0.0233	0.1909
Year Dummy	Yes	Yes
Industry Effect	Yes	Yes

Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The bigger the financing constraint index is, the more serious the financing constraint is [11] because the popularity and application of digital technology have broken through the "blind spot" of traditional financial services and enhanced the financial risk identification capability with its advantages of efficient and convenient information search and processing, prompting the financial supply to continuously tilt towards the "long tail" customer base [2]. The use of the internet, cloud computing, and other technologies, to a certain extent, solve the traditional financing approval cycle is long, complicated procedures, difficult to access, and other issues, so the development of digital finance, to a certain extent, eases the financing constraints of SMEs. The regression coefficient of Age was significantly positive at the level of 1%, and the regression coefficient of Age-sq was significantly negative at 1%. There is an inverted u-shaped nonlinear relationship between Age and financing constraints, indicating that the longer the listing age of an enterprise is, the less the financing constraints will be. The reason may be that in bank credit practice, the Age of an enterprise is not a necessary condition to determine whether an enterprise can obtain bank credit support, and banks are

more likely to provide loans based on factors such as financial performance, market share, development prospects, risk control, and others [12]. Robustness Test.

**Table 4.** Robustness test

	(1)	(2)
	Panel FE	Panel FE
VARIABLES	Finance Constraint	Finance Constraint
Aggregate Index	-0.0392 (0.0249)	-0.0416* (0.0231)
Age		3.3547* (1.7868)
Age-sq		-0.0383*** (0.0123)
Ln asset		-1.1461** (0.5609)
Ln debt		-0.5483 (0.3709)
top1		0.0005 (0.0244)
SOE=1		0.6873 (0.7526)
Foreign=1		2.2827 (1.5821)
Board Size		-0.1103 (0.2094)
No. of Independent Director		0.1899 (0.6032)
Ln salary		0.8128** (0.3725)
ROA		31.1604*** (3.5940)
Constant	5.5644*** (1.8632)	19.6975* (10.0635)
Observations	3,896	3,896
R-squared	0.0285	0.1009
Number of id	487	487
Year Dummy	Yes	Yes
Industry Effect	Yes	Yes

Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The regression coefficients of Lnasset, Board Size (BS), and No. of Independent Director (NID) were not significant, which may be due to the small size of the board, the small number of No. of Independent Director, the weak strength, the unstable operation and the relatively weak position in the market competition. Therefore, it is difficult for enterprises to obtain funds and raise funds. The coefficient of Ln debt is significantly negative at 1%, indicating that the increase in debt decreases corporate cash holdings and the smaller the financing constraints enterprises face. The regression coefficient of Top1 is significantly positive at the level of 1%, indicating that the higher the concentration of ownership, the more severe the financing constraints of the enterprise. The SOE and Foreign regression coefficients were significantly positive at 1%, indicating that both state-owned and foreign-funded enterprises face severe financing constraints. The regression coefficient of Ln

salary is significantly positive at the level of 1%, indicating that the higher the executive compensation, the more obvious the corporate financing constraint. The regression coefficient of ROA is significantly positive at the level of 1%, demonstrating that small and Medium-sized firms' accounts receivables in China are expanding year after year, squeezing out too many current assets. Year after year, the number of accounts receivable defaults or extensions rises, heightening the danger of capital chain failure and causing financing issues for small and Medium-sized businesses.

#### 4. Heterogeneity Analysis

**Table 5.** Heterogeneity analysis

VARIABLES	(1)	(2)
	Pooled OLS	Pooled OLS
	Finance Constraint	Finance Constraint
Aggregate Index	-0.0003 (0.0053)	-0.0088* (0.0050)
dummy	1.6097 (4.4676)	3.8789 (4.0477)
c.dummy#c.index_aggregate	-0.0027 (0.0165)	-0.0124 (0.0149)
Age		0.6100*** (0.1024)
Age-sq		-0.0268*** (0.0082)
Ln asset		-0.1149 (0.2575)
Ln debt		-0.5583*** (0.1701)
top1		0.0220*** (0.0069)
SOE=1		0.9174*** (0.2562)
Foreign=1		1.5083*** (0.3943)
Board Size		-0.0265 (0.0885)
No. of Independent Director		0.1589 (0.2721)
Ln salary		0.9039*** (0.1685)
ROA		41.8148*** (2.2951)
Constant	3.1302*** (0.5756)	-1.3512 (3.0183)
Observations	5,096	5,096
R-squared	0.0239	0.1912
Year Dummy	Yes	Yes
Industry Effect	Yes	Yes

Robust standard errors in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

For the robustness of the test results, this paper compares the results of the fixed effect model with the data obtained from the benchmark regression. We first use the fixed effect model to get the finance

constraint of SMEs from 2011 to 2018 and then match them with the benchmark results in the pooled regression. If the scores of the two data groups are similar or equal, we can say that their characteristics are similar. We get a balanced panel dataset of 3896 observations, and the corresponding results are shown in Table 4. It can be seen from the final estimation results that the regression values of the two groups are very close, which provides an excellent robustness check for our hypothesis.

The above empirical test has the possibility of heterogeneity bias because different types of enterprises face different financing constraints, so we need to consider whether this effect is heterogeneous for different enterprises. We regard enterprises with median or above total assets as large enterprises and generate dummy variable  $d$  to investigate whether the role of digital finance is different between large-scale and small-scale enterprises. Dummy is defined as 1 when the enterprise's total assets in the current year are greater than or equal to the 50th quantile; otherwise, it is 0. After adding dummy variable  $D$  and the product of  $D$  and digital financial index as explanatory variables, we repeated 5096 observations in the fixed-effect model and pooled regression. As shown in the data in Table 5, the interaction coefficient is not significant, indicating that the development of digital finance has no heterogeneous influence on large enterprises and SMEs, which indicates that the development of digital finance is not as credit rationing to SMEs as traditional financial institutions.

## 5. Conclusion

Financing constraints generally exist in small and Medium-sized listed enterprises in China, and there is a big difference, enterprise age, the number of shares held by the first shareholder, ROA will affect financing constraints. According to the benchmark regression results obtained in Table 3, the development of inclusive digital finance has alleviated the financing constraints of SMEs to a certain extent. The  $\text{Lnasset}$  index, Board Size (BS) index, and No. independent director (NID) index have no significant influence on financing constraints. Age, Top1, SOE, Foreign, Ln salary, and ROA have significantly deepened the financing constraints of SMEs. However, the Ln debt index significantly eased the financing constraints of SMEs. By comparing the fixed effect model with the pooled regression data, we ensured the robustness of the experimental data. In the heterogeneity analysis, we found that the development of digital finance had no heterogeneous impact on large-scale enterprises and SMEs.

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