Coverage breadth of digital finance and SMEs' financing constraints

Jingfang Luo[1, a, †], Jiarou Wu[2, b, †]

[1]Qingdao No.16 Middle School, Qingdao, Shandong, China

[2]Hainan Middle School, Haikou, Hainan, China

[a]luojingfang0329@163.com, [b]guanghua.ren@gecacademy.cn

[†]These authors contributed equally.

Abstract. Digital finance, as a new generation of financial services combining Internet and information technology with traditional financial services, has had a significant impact on enterprise financing. This paper takes China's A-share listed companies from 2011 to 2018 as samples to explore the impact of digital finance on SMEs' financing constraints. Research shows that the development of digital finance can effectively alleviate the financing constraints of SMEs. In the fourth part of this paper, the robustness test is carried out by using the fixed-effect model, and the empirical results are unchanged. The research in this paper shows that the development of digital finance is an important supplement to traditional finance.

Keywords: digital finance, SMEs' financing constraints, regression model

1. Introduction

Digital finance, a new financial model, is a combination of digital technology and the traditional financial sector, consolidating and further shaping the current global financial environment. Nowadays, digitalization has inevitably become the dominant trend in the majority of industries, covering ABC--artificial intelligence, big data, cloud computing, and blockchain technology, etc., which contribute a vast range of benefits to this society. The most obvious one is that they could be used without the restrictions of time and space and even without the boundary of countries. Besides, the data could penetrate the market both vertically and horizontally, which means that most intermediaries and classes can be dissolved so that the transaction could become peer-to-peer, while blockchain and digital currencies play important roles in shortening the industry chain. Due to these benefits, capital markets have always attached great importance to the application and development of digital technology. And in terms of innovation, institutions in this field are actively using artificial intelligence, big data, and many other technologies to provide investors with more intelligent and cutting-edge innovative financial services. In this financial industry as a whole, developing digital finance aims to promote and strengthen the efficiency and ability of the financial services entity economy through technological innovation in the core areas of digital technology.

Based on current research, SMEs account for a large proportion of the overall market, but a small share of assets and most of the resources are held by large companies so there will be strong competition within SMEs resources. And from the information asymmetry, the financing credit assessment survey is flawed. Many dare not lend, and the amount of loan is always small, which means that for SMEs, there is a vicious cycle of financing, that is, the lack of funds - credit problems - third parties dare not to lend - the lack of funds constraints.

According to the theory presented by Parker, S. C. in 2012[1]. As the most active part of the market, innovation, and entrepreneurship have become their driving forces and goals, helping technological development and revolution, and also making a great contribution to the provision of employment. That's why we're making incentives for small and medium-sized businesses. According to results discovered by Thorsten Beck in 2007[2], We find that the financing constraints of SMEs are mainly focused on the following areas, financing costs, financing channels, and economic environment, The study shows that 35% of SMEs are more concerned about the cost of finance， while other 30% are

limited to access to finance. Tax rate, macroeconomic instability as the main factors of business environment also is worried. And because of information failure, leading to banks to SMEs research is too low, which led to bank loans accounting for less than evenn10 percent of the financing needs of small and medium-sized enterprises. According to a research report jointly released by INTERNATIONAL Finance Corporation (IFC), on average, SMEs account for more than 90% of all enterprises with insufficient or no financing. The innovation financing cycle is long, the risk is big, it is even more difficult for small and medium-sized enterprises.

Society is always constructed within a specific technological context, both in terms of supply and needs as well as perceptions of the society supported by technology. In other words, the modern financial system has always been embedded in a particular technology, economy, and society, which is now constantly changing the way it is shown as technology advances. Currently, it is mainly based on electronic technology, especially the Internet. In this context, inadequate and asymmetric information are prevalent, requiring the use of marketplaces and authoritative third-party institutions to boost trust and improve the efficiency of "many-to-many" transactions. Some scholars pointed out that digital finance with the long-tailed group due to its better policy orientation has a positive contribution to the alleviation of corporate financing constraints, as it can alleviate information asymmetry to a certain extent and help break down traditional financial barriers, while also extending the boundaries of financial services. Inevitably, some scholars are upholding contradictory views, pointing out that digital finance has been developed for a relatively short period, and its technology, operation, and management model still have great space for improvement and enhancement, coupled with the scope for arbitrage caused by regulatory lag, regulatory gaps, and regulatory overlap, making it unable to improve enterprise financing constraints fundamentally [3-4].

In China, the reform of financing constraints for small and medium-sized enterprises is mainly concentrated in 2016, with the G20 summit, the Organization for Economic Cooperation and Development (OECD), the National Conference on Science and Technology Innovation, and other important conferences held in full, with the theme of financing constraints for small and medium-sized enterprises development reform and followed. Since 2004, the People's Bank of China has been promoting the construction of a centralized and unified enterprise and an individual credit system for more than 10 years, gradually improving the credit system for SMEs, developing diversified financing channels for them, and striving to promote the development of mortgage loans and guarantee systems for intangible assets. But overall, SMEs in developing countries in China and around the world have very obvious financing barriers.

This paper would make extensive use of econometrics to model, identify causality and find a link between digital financial coverage and SMEs development, to evaluate and project the future so that further research in terms of the breadth and depth of digital finance could be done to determine the impact of different circumstances on corporate financing constraints.

This paper is organized as follows: Part 2 presents the literature review; Part 3 introduces the empirical model, summary statistics, and variables' definition. Section 4 shows empirical results. Section 5 makes conclusions and future extensions.

2. Literature Review

The topic of financing constraints for SMEs has been emerging since the 21st century, and recent research showed that how the risks involved in SME lending and the difficulties of transaction cost management have made financial institutions and markets so reluctant to engage with such enterprises, especially in developing countries, where market exclusion is limited, weak government policies and pressure from large companies are particularly evident [2]

The same is true in Europe, where developed countries are concentrated. Whether the finance constraints hinder the growth of SMEs in Europe or not is one of the problems [5]. Cash flow sensitivity is the basic nature of small and medium-sized enterprises. The results show that the sensitivity of corporate growth to cash flow increases with the decline in the size of the company and

that SMEs did encounter financing constraints that prevented them from fully exploiting their growth potential during the 1996-2000 sample period.

Digital finance means financial services delivered by banks and non-banking. As a new technology, academic discussions have focused on the use of mathematical models in most of these literature in 2019-2021 to conduct a series of quantitative analyses to reach conclusions, according to R. Rasheed, Sulaman Hafeez Siddiqui, Iqbal Mahmood, S. Khan less said in 2019, Bank financing as the main source of funding for small and medium-sized enterprises, but due to information insanity and other factors have gradually become the main obstacles to the development of SMEs [6]. In this paper, financial institutes to their customers through linkage of digital mediums like mobile phones, internet, and cards with secure digital payment systems. Digital finance adoption can overcome the issues that persist for individuals, businesses, governments, and economies. Digitization impacts and raises the level of financial inclusion along with several benefits like reduction in financial cost for financial institutes and Fintech providers, convenient and secure financial services, improvement in the gross domestic product (GDP), and long-term positive impact for banking performance.

Further research has proved that [7,8], The development of digital finance can promote low- and middle-income families to eliminate fees, serve the long-tailed population, and thus achieve inclusive growth. Although most of the existing literature is positive about the relationship between digital finance and financing constraints before, according to Liqiong Lin, Weizhuo Wang, C. Gan, D. Cohen, and Q. Nguyen taking China as an example of a country with a wide geographical area in 2019, the regional financial development is very different, resulting in different regional enterprise financing infrastructure environment, digital inclusive finance on enterprise financing constraints to ease the utility of the play to a certain extent by the regional traditional financial services[9]. Moreover, the long tail group is the main service object of digital finance. A prominent feature of this group is that the "bad credit" characteristic is more sudden; From the financing, supply-side to see, the large number of small and medium-sized digital inclusive financial platforms is not equipped with the high-end configuration of big data technology, in its short development time, technology, science, and operating system to be further improved, information asymmetry problems will persist, making it impossible to effectively improve the efficiency of screening high-quality projects in practice. This mismatch between financing supply and demand may be difficult to effectively realize the mitigation of enterprise financing constraints.

Through literature collation, we found that: As a common problem faced by the global countries, the problem of financing constraint of small and medium-sized enterprises has been paid more and more attention to with the continuous development of society and economy, and digital inclusive finance has provided a new way of thinking on such problems. However, there are regional differences in digital finance, that is, when the development of the regional financial sector is relatively good, the financing needs of enterprises in the region have been met to a certain extent, the positive impact of digital finance on enterprise financing may show a trend of diminishing marginal income. On the other hand, when the development level of regional banking and capital market is poor, the shortage of financial supply leads to strong financing constraints for enterprises in the region. At this point, the marginal improvement of external financial supply brought about by digital inclusive finance will improve the financing constraints of enterprises. The subsequent empirical research of this paper will include the influencing variable of regional difference, that is, the text will identify the mitigation ability of digital finance to the financing constraints of small and medium-sized enterprises caused by studying the digital inclusive financial index of different cities.

3. Research Design

3.1. Data Source

The digital finance index used in this research is derived from The Peking University Digital Inclusive Finance Index, and the enterprise data of all the experimental subjects are derived from the CSMAR database. The Institute of Digital Finance, Peking University is committed to conducting

academic research in the fields of digital finance, financial technology, financial inclusion, and financial reform, providing authoritative scientific research results to the community, as well as theoretical guidance for industry development and scientific reference for government decision-making. The CSMAR database is an authoritative and accurate financial database, designed and developed by Guotaian for the needs of experts and scholars from universities, financial and securities institutions, and social research institutions for financial and economic analysis and research in China. The sample consists mainly of A-share listed companies across China and excludes financial companies, ST and *ST companies, as well as those with missing data. Besides, a 1% bilateral tailing process is applied to all continuous variables by using Stata to avoid the influence of extreme values on the results.

3.2. Model Specification

In order to investigate the impact of the digital finance index on corporate financing constraints, the following empirical model in which X stands for all control variables is constructed.

(1) Dependent variable. SA-Index. SA-Index=-0.737×Asset+0.043×Asset2-0.040×Age, in which the asset is the natural logarithm of the company's total assets (in million yuan); Age is the time when the company is listed. The SA index is calculated by using a model constructed by reference [10] as a variable of the firm's financing constraint. This paper converts the SA index into positive numbers. The larger the value, the more severe the financing constraints of the enterprise.

(2) Coverage breadth, a set of data from Peking University Digital Inclusive Finance Index. This index contains three dimensions: scope of coverage, depth of use, and services of digitalization, providing a comprehensive picture of the development and trends of digital finance in China at the provincial and municipal levels.

(3) Control variable. To further improve the regression precision of the study, relevant control variables were included in this study as possible, including the logarithm of total assets, debt to asset ratio, ROA, list ages, top 1, salary, board size, SOE, foreign enterprises. At the same time, variables year and industry are also controlled. The specific definitions of the relevant variables are shown in Table 1.

Table 1. Specific definitions of variables

Nature of variables	Variable	Explanation of Variables
Dependent Variable	SA-Index	Financing constraint index calculated by drawing on the model built by Hadlock, Charles J, et al.
Independent Variable	Coverage Breadth	Digital Inclusive Finance Index constructed by Peking University's Digital Finance Research Centre
Control Variable	Age	List ages of enterprises
	Age-sq	The square of list ages of enterprises
	ROA	Net profit /total assets
	Ln debt	The logarithm of debt to asset ratio
	Ln asset	The logarithm of total assets
	Board Size	Number of board members
	Top1	The first big proportion of shareholding
	Ln salary	executive compensation
	SOE=1	State-owned enterprise=1, 0 otherwise
	foreign=1	Foreign enterprise=1, 0 otherwise
	No. of Independent Director	Number of independent directors
	year	Set variables by year
	industry	Set variables by industry

3.3. Summary Statistics

Descriptive statistics are shown in Table 2. As can be seen from it, the mean value of the digital financial index is 3.3407, the standard deviation is 0.1449, the minimum value is 2.8651, and the maximum value is 3.718, indicating that the level of financing constraints varies less among different enterprises. The mean of state-owned enterprises is 0.1822, while that of foreign-funded enterprises is 0.0511. These two percentages show that 18% of the sample are state-owned enterprises and 5% are foreign-owned enterprises. In addition, the mean value of Coverage breadth is 184.7663, which is smaller than the median, indicating a left-skewed distribution of digital finance coverage, suggesting that digital finance is becoming more widely used.

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
SA index	3896	3.3407	.1449	2.8651	3.718	3.3494
Coverage Breadth	3896	184.7663	61.9262	5.1	290.3175	190.8668
Age	3896	5.799	3.07	0	14	6
Age-sq	3896	43.0511	39.3293	0	196	36
Ln asset	3896	21.893	.9503	19.1987	26.1516	21.8003
Ln debt	3896	20.7332	1.3676	17.4067	25.9776	20.7146
top1	3896	33.7036	14.5869	4.15	86.49	31.91
SOE=1	3896	.1822	.3861	0	1	0
Foreign=1	3896	.0511	.2202	0	1	0
Board Size	3896	8.4458	1.5004	5	15	9
No. of Independent Director	3896	3.114	.4768	2	5	3
Ln salary	3896	14.8055	.7443	11.9685	16.9982	14.7863
ROA	3896	.0479	.0582	-.3281	.2342	.0443

4. Empirical Results

Table 3 is an empirical result of the benchmark regression. To better determine the influence of digital finance on the corporate finance constraints, this study adopts the progressive regression principle, and model (1) only considers the independent variable based on controlling variables: time and industry. The study found that the coefficient of coverage breadth's influence on the corporate financing constraints was negative and significant, which meant that the financing constraints of SMEs improved significantly under the influence of digital finance. To verify the reliability of this result, the control variable set is then covered in model (2), and it is found that digital finance still has a good mitigation effect on SMEs' financing constraints. This fully shows that the development of digital finance can help reduce corporate financing constraints.

Table 3. Benchmark regression

VARIABLES	(1) OLS SA Index	(2) OLS SA Index
Coverage Breadth	-0.0002***	-0.0001**
	(0.0001)	(0.0000)
Age		0.0399***
		(0.0016)
Age-sq		-0.0002
		(0.0001)
Ln asset		-0.0006
		(0.0047)
Ln debt		0.0114***
		(0.0019)
top1		0.0001
		(0.0001)
SOE=1		0.0038
		(0.0027)
Foreign=1		0.0051*
		(0.0028)
Board Size		0.0033***
		(0.0011)
No. of Independent Director		-0.0050*
		(0.0029)
Ln salary		0.0001
		(0.0018)
ROA		0.0850***
		(0.0199)
Constant	3.1832***	2.8478***
	(0.0081)	(0.0705)
Observations	3,896	3,896
R-squared	0.5282	0.8354
Year Dummy	Yes	Yes
Industry Effect	Yes	Yes

5. Robustness Test

Table 4 is the estimated results of the robustness test. The results in column (1) only include the breadth of digital finance coverage, year-fixed effects, and industry-fixed effects. It can be found that the coefficients are not significant, and this result may be caused by omitted variables.

In the estimated results in column (2), the coefficient of the coverage of digital finance is -0.0004, which is significant at the 5% level, indicating that the development of digital finance has a significant negative impact on the financing constraints of SMEs. The conclusions of this article are robust.

Table 4. Robustness test

VARIABLES	(1) Panel FE SA Index	(2) Panel FE SA Index
Coverage Breadth	-0.0003	-0.0004**
	(0.0002)	(0.0002)
Age		-0.0322
		(0.0253)
Age-sq		-0.0001
		(0.0001)
Ln asset		0.0183**
		(0.0080)
Ln debt		0.0109***
		(0.0037)
top1		-0.0004
		(0.0003)
SOE=1		-0.0275***
		(0.0098)
Foreign=1		-0.0068
		(0.0084)
Board Size		0.0007
		(0.0016)
No. of Independent Director		0.0064*
		(0.0035)
Ln salary		-0.0031
		(0.0032)
ROA		0.0308
		(0.0196)
Constant	3.1950***	2.7106***
	(0.0137)	(0.1550)
Observations	3,896	3,896
R-squared	0.9104	0.9211
Number of id	487	487
Year Dummy	Yes	Yes
Industry Effect	Yes	Yes

6. Conclusion

Overall, the entire article examines the impact of digital inclusive finance on the financing constraints of small and medium-sized enterprises. Based on the previous literature and related theoretical knowledge, through the linear regression model to make a series of assumptions about the subjects and repeated verification, through China's A-share 2011 to 2018 small and medium-sized board as an example, we find that digital inclusive finance can effectively alleviate the financing difficulties of small and medium-sized enterprises. Through robust testing, we were given a consistent result at the end.

Based on data and other factors, we are not sure whether digital finance can overcome time changes and its internal risks. Lack of depth resolution for multiple dimensions. As basic research, this paper hopes to provide effective suggestions for the follow-up investigation.

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