The Impact of Digital Finance Breadth Coverage on Financing Constraints

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Abstract: Digital finance, as an emerging form from the integration of finance and technology, has an important impact on the real economy. Financing constraint such as limited credit availability and high financing cost has long been an issue that brings serious consequences to enterprises in China. By using the data of A-share listed firms in Shanghai and Shenzhen stock markets and the digital finance inclusive index published by Peking University, an empirical model is established to gain an insight into what impact digital finance has on financing constraints regarding its breadth of coverage. At the same time, this paper makes further heterogeneity analysis from the perspective of enterprise size, adds interaction terms for regression analysis, and carries out a robustness test to confirm the conclusion. The empirical results show that the wider digital finance covers geographically, the stronger the mitigating effect on financing constraints. In its early development stage, digital finance benefits more to large enterprises, but with its continuous improvement, it will gradually eliminate size discrimination. The above conclusion still holds after the robustness test. The research results will assist in guiding the development of digital finance and strengthening its ability to serve the real economy.

1. Introduction

The development of digital finance in China has gone through three stages. The first stage began with the internetization of traditional financial institutions in the 1990s. China's commercial banks began to promote the IT-based back-end services and offer financial services through ATM, online banking, and other terminals by gaining experience from those in developed countries. The second stage is the era of Internet finance. When Alipay system was successfully released in 2004, digital finance officially came into being and developed rapidly after Yu 'E Bao was created in 2013 [1]. During this period, fintech enterprises took advantage of their massive users and digital technology to offer financial services such as mobile payment and peer-to-peer lending, resulting in the inclusiveness and commercialization characteristics in digital finance [2]. The third stage from 2017 until now, is where traditional financial institutions and fintech enterprises realize financing, payment, investment, and other new financial business modes through digital finance. In this way, a more mobile, intelligent, and scenario-based comprehensive financial service platform is gradually built [3].

The sustainable and stable development of enterprises requires sufficient financial support while financing constraints will bring different economic consequences to enterprises. In terms of investment behavior, when financing constraint is strong, enterprise operators will carefully consider investment projects to avoid economic losses, leading to lower investment efficiency [4]. From the cash holdings aspect, Weng Min and Geng Chengxuan discovered that financing constraints could positively promote enterprise cash holdings, as they tended to invest with internally retained earnings to reduce uncertainty [5]. For enterprise innovation, most scholars believe that financing constraints inhibit enterprise innovation, as the stable capital inflow required for enterprise R&D activities is hindered by financing constraints [6]. The reasons for financial constraints can be divided into external and internal

factors. External factors include regional financial development levels and external information. Corporate financing constraints are more likely to be relieved by a sound regional monetary system [7], and a high degree of information sharing determines a smoother process in obtaining external financing [8]. Internal factors include ownership nature and internal control. State-owned listed companies face dramatically lower degree of financial constraints than private listed companies [9]. Besides, as imperfect internal control exists in small and medium-sized enterprises (SMEs), the resulting inadequate disclosure of quantitative information such as financial statements has hindered financial institutions from confirming SMEs' repayment abilities [10], resulting in financing constraints.

With information's development technology, digital finance relied on the Internet only to achieve transmission and inefficient data collection. Now, with digital finance's development. The financing constraints of enterprises can be reduced to a greater extent. The relationship between corporate financing constraints and digital finance is mainly as follows:

First, digital finance alleviates information asymmetry through big data, artificial intelligence, and blockchain, thus reducing the marginal cost of enterprise financing. Second, digital finance broadens financing channels.

Easier financing and loans for small businesses and small customers and get more funding. Ease enterprises' financing constraints significantly [11].

The second is to enhance the ability of finance as a carrier to collect information. Companies need to obtain sufficient funding to sustain innovation activities. This should improve the company's financing ability and the effectiveness of the financial environment [12].

On one hand, digital finance improves the availability of credit [13]. On the other hand, it indirectly promotes competition and business innovation among traditional financial institutions. Therefore, digital finance can effectively reduce the financing constraints of enterprises.

China is currently in the third stage of digital finance development, with traditional financial institutions and Internet startups integrating for the first time. From the perspective of fund use scenarios of small and medium-sized enterprises, it is mainly divided into the following five situations [14]. 1. Financial market: contract signing, informatization analysis, asset verification, etc. 2. Payment settlement: mobile payment, virtual currency, etc. 3. Financing: listing crowdfunding, Internet loans, etc. 4. Investment management: Internet transactions, virtual consultants' consultation, etc. 5. Insurance: Internet insurance, etc. From the current development of digital finance in China, the early development is greatly affected by emerging digital financial institutions. In recent years, there has been a new trend that traditional financial institutions have become the leaders of digital finance. Its division of labor is very clear. Internet technology companies provide technical support such as artificial intelligence and network algorithms, and financial institutions use digital finance to improve service efficiency. In terms of business scope, it has expanded from Internet payment, information-based loans, online consulting services to intelligent investment consultants, digital currency, and other fields. In terms of risk control, traditional risk control and information risk control are combined to achieve the integration of service coverage and accuracy. These functions assist small and medium-sized businesses in overcoming their financial constraints.

Academic research on the relationship between digital finance and funding restrictions of small and medium-sized firms, according to the available literature, focuses on the impacts of allocating suitable resources, finding benefits equivalent to risks, reducing financing threshold, and reducing the unemployment rate. The conclusion is that digital finance will alleviate the problem of financing constraints. These studies provide research methods and ideas for this paper, but there are still have some limitations. Currently, most studies focus solely on the implications of digital banking on the financial restrictions of small and medium-sized businesses, lack of research on the breadth of practical coverage, and need some practical data to support.

This paper believes that it should be started from the coverage of digital finance, based on the development of digital finance in China, and the integration with the traditional financial industry, by collecting data from enterprises of different scales, and presenting empirical results and heterogeneity analysis in subsequent articles to discuss digital finance. The influence of financial coverage on small

and medium-sized businesses' funding restrictions. The conclusion is that the greater the coverage of digital finance, the more beneficial it is to ease the financing constraints of small and medium-sized enterprises.

The following parts of this paper are arranged as follows: the second part is the research design; The third part is the empirical results; The fourth part is the robustness test; The fifth part is the conclusion.

2. Research design

2.1 Data

The data in this research comes from the digital inclusive finance index of Peking University from 2011 to 2018. The data range of this paper is from 2011 to 2018, covering 31 provinces (municipalities and autonomous regions directly under the central government, hereinafter referred to as "provinces"), 337 cities above prefecture level (regions, autonomous prefectures, leagues, etc., hereinafter referred to as "cities") and about 2800 counties (county-level cities, banners, municipal districts, etc., hereinafter referred to as "counties") in mainland China. The province and city-level indices cover the years 2011 to 2018, while county-level indexes cover the years 2014 to 2018. The data of A-share enterprises in Shanghai and Shenzhen comes from the China stock market &amp. Accounting Research Database (CSMAR). The CSMAR takes Center for Research of Security Prices (CRSP), Compustat, New York Stock Exchange Trades and Quotes (NYSE TAQ), Thomson, and other authoritative databases as professional standards. It covers 18 series, including factor research, character characteristics, green economy, overseas, information, stocks, funds, bonds, industries, companies, economy, commodities futures, and so on. The CSMAR is a research-based and accurate database in the economic and financial fields. It was established according to China's current national conditions.

2.2 Model design

In this paper, OLS is used to analyze the impact of digital finance breadth coverage on enterprise financing constraints,

$$y_i=\alpha_0+\alpha_1*\text{Coverage Breadth}_c+x_i'\beta+\varepsilon_i \quad (1)$$

In Formula (1), y_i is SA index, indicating the financing constraint level of small and medium-sized enterprises; $\text{Coverage Breadth}_c$ is the explanatory variable, and c represents the local level city where the enterprise is located; x_i represents the control variables, including total assets at the end of the period, total liabilities at the end of the period, the length of time the enterprise is listed, the shareholding proportion of the largest shareholder (%), State-Owned Enterprise (SOE, 1 for state-owned enterprises, otherwise 0), foreign-funded enterprises (1 for foreign-funded enterprises, otherwise 0), the number of directors on the board of directors, the number of directors who are independent, executive compensation and return on assets.

2.3 Variable introduction

2.3.1 SA index

It is defined as 0.737 × Asset+0.043 × Asset2-0.040 × Age, where the asset is the natural logarithm of the total assets of the enterprise (in millions of Yuan); Age is the listing time of the enterprise. The SA index value is negative, which is converted into a positive number in this paper. The larger the value is, the more serious the financing constraints are.

2.3.2 $Coverage\ Breadth_c$

$\text{Coverage Breadth}_c$ is the explanatory variable, and c represents the local level city where the enterprise is located. The coverage of digital finance is measured by the coverage of accounts in the digital inclusive finance index of Peking University (2011-2018). The value of Alipay, according to

this research, is closely tied to account coverage and may correctly indicate the coverage of digital banking. Specific indicators include the number of Alipay accounts per 10000 people, the percentage of Alipay card users, and the average number of bank cards per Alipay account.

2.3.3 Control variable

Referring to the previous literature, the control variables in this paper include total assets at the end of the period, total liabilities at the end of the period, the length of time the enterprise is listed, the shareholding proportion of the largest shareholder (%), State-Owned Enterprise (SOE, 1 for state-owned enterprises, otherwise 0), foreign-funded enterprises (1 for foreign-funded enterprises, otherwise 0), the number of directors on the board of directors, the number of directors who are independent, executive compensation and return on assets. To improve the accuracy of the data, this paper screened the initial samples as follows: 1. Excluding the company samples in the financial industry. 2. Excluding the company samples that were ST and * ST. 3. Excluding the samples with missing values of variables. 4. Considering the influence of extreme values, the winsorize method was used to conduct a 1% bilateral tail reduction on the main continuous variables. The descriptive statistics for the variables are listed in Table 1:

Table.1. Descriptive statistics

Variable	***N***	***Mean***	***Std.Dev.***	***Min***	***Max***
Coverage Breadth	18854	193.2397	60.7071	-10.49	290.3175
SA index	18854	3.4578	0.314	2.3213	4.1579
Asset, unit: 10000 Yuan	18854	1309503	4177095	18657.98	45434239
Debt, unit: 10000 Yuan	18854	802120.3	2967421	3627.572	33624640
Age	18854	9.5128	7.2835	0	25
top1	18854	35.082	15.2319	0.29	99
SOE=1	18854	0.3766	0.4845	0	1
Foreign=1	18854	0.0482	0.2141	0	1
Board Size	18854	8.6247	1.7189	5	15
No. of Independent Director	18854	3.1852	0.5694	2	5
Salary, unit: 10000 Yuan	18854	370.8776	357.9202	15.7712	2411.08
ROA, %	18854	4.4138	6.3487	-32.8121	23.4179

Note: N represents the sample size which covers China's listed companies from 2011 to 2018.

2.4 Descriptive statistics analysis

The following table reports statistical descriptive characteristics. The table statistics are displayed. Coverage Breadth has a mean of 193.23. The SA index should have been all negative. But absolute value processing has been done. The higher the absolute value of the SA index. Financing constraints are more severe. The mean value of the SA index in the table below is 3.46. Take a positive number. This indicates the degree of financing constraints imposed on enterprises is more serious. This reflects the low coverage of digital finance in China. This led to the difficulty of financing the company.

3. Empirical Results

3.1 Benchmark Regression

Based on sample data. Use the least-squares method. estimated data. Get a linear regression model. The goodness-of-fit column (1) was found to be 0.0017. Column (2) is 0.8786. Column (3) is 0.1684. Section (4) is 0.8865. Predict how well the regression line fits. The maximum value of R-squared is 1. R-squared's value is close to 1. This shows that the regression line fits the measured values well. However, the value of column (1), column (2) is very small. Therefore, it is not suitable to be used as a benchmark regression result. Therefore, compare the results of column (2) and column (4).

Based on the estimated results in the table below. The development of digital finance has a bad impact on the SA index. After adding the industry, year control variables in column (4). Subject to

column (4), the degree of digital financialization has increased by 1 unit. The SA index fell by 0.0018. This result can be explained as the development of digital finance effectively alleviates corporate financing constraints.

Table.2. Benchmark regression

Variables	**OLS**			
	SA index	***SA index***	***SA index***	***SA index***
Coverage Breadth	-0.0002***	0.0000	-0.0012***	-0.0018***
	(0.0000)	(0.0000)	(0.0001)	(0.0000)
Age		0.0502***		0.0496***
		(0.0005)		(0.0005)
Age-sq		-0.0004***		-0.0004***
		(0.0000)		(0.0000)
Ln asset		-0.0476***		-0.0451***
		(0.0029)		(0.0030)
Ln debt		0.0185***		0.0195***
		(0.0015)		(0.0016)
top1		-0.0002***		-0.0001
		(0.0001)		(0.0001)
SOE=1		-0.0061***		-0.003
		(0.0021)		(0.0021)
Foreign=1		-0.0016		-0.0018
		(0.0032)		(0.0033)
Board Size		0.0077***		0.0073***
		(0.0010)		(0.0009)
No. of Independent Director		-0.0293***		-0.0264***
		(0.0027)		(0.0026)
Ln salary		0.0156***		0.0162***
		(0.0014)		(0.0014)
ROA, %		0.0014***		0.0013***
		(0.0002)		(0.0002)
Constant	3.4166***	3.4941***	3.3247***	3.4012***
	(0.0071)	(0.0380)	(0.0248)	(0.0379)
Observations	18,854	18,854	18,854	18,854
R-squared	0.0017	0.8786	0.1684	0.8865
Data	Unbalanced	Unbalanced	Unbalanced	Unbalanced
Industry Dummy	No	No	Yes	Yes
Year Dummy	No	No	Yes	Yes

Note: The results are rounded-up to 4 digits after the decimal point. Standard errors are shown as parenthesized numbers. The 1%, 5%, and 10% significance levels are expressed as ***, **, and * respectively.

3.2 Heterogeneity Analysis

The results from the above empirical test are difficult to avoid heterogeneity bias, which is because, for enterprises in different conditions, the effects of digital finance on corporate financial investment can vary. Therefore, this article further divides the heterogeneity characteristics of enterprises according to their sizes: first, the 'Size' variable is introduced (the variable is set as 1 when the current year sum of enterprise assets are above 50 quantiles, otherwise it is set as 0). Then the interaction term 'Size × Coverage Breadth' is formed by the variable 'Size' and digital finance inclusive index of the prefecture-level cities where the listed companies' offices are located. After that, the interaction term is added into the regression equation to conduct a heterogeneity analysis based on enterprises' sizes. By reviewing the regression results provided by Table 3, the 'Size × Coverage Breadth' term in column (1) demonstrate itself as significantly negative at the 1% level, which reveals that large enterprises benefit more from digital finance. The reasons may be as follows: large enterprises have a stronger

ability to deal with risks due to their comprehensive disclosure of quantitative information such as financial statements and transaction flows and more disposable high-value collateral [13]. Therefore, digital financial service resources at the early stage tend to flow to the high-quality channels of large enterprises. However, after the dummy variables representing years are added to columns (3) and (4), it can be found that the interaction term is no longer significant both before and after the addition of control variables. The results demonstrate that there is no scale heterogeneity in the impact of digital financial on financing constraints when the temporal trend is considered. The possible explanation for this result can be that digital finance is improving over time and will gradually eliminate the phenomenon of "size discrimination", enabling the small-scale enterprises to receive the same credit support from financial institutions as large-scale enterprises.

Table.3. The impact of digital finance on financing constraints of enterprises with different sizes

Variables	**OLS**			
	SA index	***SA index***	***SA index***	***SA index***
Coverage Breadth	-0.0008***	-0.0015***	-0.0028***	-0.0012***
	(0.0000)	(0.0000)	(-0.0001)	(-0.0001)
Size	0.4391***	0.1398	0.3252**	0.0593
	(-0.1495)	(-0.1232)	(-0.1512)	(-0.1211)
Size × Coverage Breadth	-0.0012**	-0.0005	-0.0007	-0.0003
	(-0.0005)	(-0.0004)	(-0.0005)	(-0.0004)
Constant	3.1473***	2.5611***	3.1234***	2.5106***
	(-0.0044)	(-0.064)	(-0.067)	(-0.0638)
Observations	5,096	5,096	5,096	5,096
R-squared	0.2257	0.8571	0.2938	0.8684
Data	Unbalance	Unbalance	Unbalance	Unbalance
Control Variable	No	Yes	No	Yes
Industry Dummy	No	No	Yes	Yes
Year Dummy	No	No	Yes	Yes

Note: The results are rounded-up to 4 digits after the decimal point. Standard errors are shown as parenthesized numbers. The 1%, 5%, and 10% significance levels are expressed as ***, **, and * respectively.

4. Robustness test

Table.4. The regression results of robustness test

Variables	**Panel FE**			
	SA index	***SA index***	***SA index***	***SA index***
Coverage Breadth	-0.0017***	-0.0025**	-0.0036***	-0.0049***
	(0.0000)	(0.0000)	(-0.0001)	(-0.0001)
Constant	3.2142***	3.1493***	3.2502***	3.0865***
	(-0.0080)	(-0.1181)	(-0.0898)	(-0.1243)
Observations	13,344	13,344	13,344	13,344
Number of id	1,668	1,668	1,668	1,668
Data	Balanced	Balanced	Balanced	Balanced
Control Variable	No	Yes	No	Yes
Year Dummy	No	No	Yes	Yes

Note: The results are rounded-up to 4 digits after the decimal point. Standard errors are shown as parenthesized numbers. The 1%, 5%, and 10% significance levels are expressed as ***, **, and * respectively

To further improve the reliability of the conclusion, the Panel Fixed Effect FE (Panel FE) method will be adopted in this article for robustness test. The reasons for choosing the Panel FE method are as follows: compared with the OLS method, on one hand, the Panel FE method solves the endogenous issue of omitted variables that do not change with time. In other words, since digital financial develops over time, the Panel FE method can effectively reflect the temporal effect. On the other hand, the Panel

FE method provides more information on the dynamic behaviors of digital finance from the two dimensions of cross-section and time. From Table 4, it can be inferred that whether it is columns (1) and (2) which are added the control variables before and after respectively, or columns (3) and (4) which both consider the dummy variables representing years before and after adding control variables, the results all illustrate that the coefficients representing digital finance's breadth of coverage are significantly negative at the 1% level. The finding further acts as proof of the core conclusion of this article: The wider the breadth of coverage of digital finance, the stronger the mitigation effect of corporate financing constraints it exerts.

5. Conclusion

Using the data of Peking University Digital inclusive finance index and CSMAR from 2011 to 2018, this article investigates the influence of digital finance coverage on the financing of small and medium-sized businesses. The study discovered that the development of digital finance has a higher influence on large businesses than on small and medium-sized businesses. The reason is that large enterprises can regularly disclose more comprehensive information and have more high-value collateral. Therefore, the default risk of large enterprises is lower, and digital financial services tend to flow to high-quality channels. These factors also act as a stumbling block to the growth of small and medium-sized businesses. This paper also found that digital finance is improving over time and will gradually eliminate the phenomenon of "size discrimination", enabling small-scale enterprises to receive the same credit support from financial institutions as large-scale enterprises. For further research, this paper uses the robustness test to obtain more dynamic behavior information of digital finance from the two dimensions of cross-section and time. The conclusion is that the greater the coverage of digital finance, the stronger the mitigation effect of corporate financing constraints. This study provides the following illumination based on the preceding conclusions.

First, digital finance breaks through the dependence on physical outlets, which is the integration of traditional financial industry and digital technology. With the development of time, digital finance is getting better and better. While expanding business in the traditional banking industry, makes business loans, financing, and other businesses more concise and convenient. This can continuously provide diversified services for long-tail users. For different types of small and medium-sized enterprises, it is conducive to alleviating the financing pressure and promoting the further release of economic vitality. Second, the development of digital finance needs to strengthen the innovation of digital technology. By integrating 5g networks, cloud computing, artificial intelligence, blockchain, and other technologies, digital finance will be further changed and optimized in quality. Third, the current openness of digital finance needs to be further strengthened, and the country needs to proceed from monetary and fiscal policies. Lowering the threshold, encouraging innovation, and promoting the reduction of industry loan interest rates. Improve the flow of finances and make it easier for small and medium-sized businesses to get financing. Fourth, digital finance is a new financial model. To prevent the occurrence of systemic financial risks, the regulatory authorities need to regulate the enterprise financing process on the premise of fairness and justice. Fifth, expand the coverage of digital finance. This paper advocate adjusting measures to local conditions. Distinct regions of China have different funding situations for small and medium-sized businesses, and customized systems should be implemented for enterprises in different regions. Improve the financing system, credit conditions, and market conditions in different regions. Thus, by expanding the coverage of digital finance, it can alleviate the financing difficulties of small and medium-sized enterprises.

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