The Impact of Digital Inclusive Finance on Corporate Leverage Ratio—Evidence from Listed Companies in the SME Board of China

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Abstract: Small and medium-sized enterprises (SMEs), which drive China's economy, have faced debt risk, financing difficulties, and financing prices due to a lack of hard financial information for the past decade. Digital inclusive finance is seen as the solution. This research examines how digital inclusive finance affects SMEs' leverage ratios using a 2011–2021 sample of former SME board listed enterprises. The study found that: digital financial inclusion has a significant negative impact on enterprise leverage; it can reduce its own leverage by improving cash flow and reducing long-term debt ratios; and the effect is greater in non-state-owned and "maturity stage" enterprises. The contributions of this research lie in demonstrating that digital financial inclusion mitigates in SMEs' corporate debt risk. Additionally, it identifies a novel transmission mechanism influencing corporate leverage. These findings have the potential to play a crucial role in preventing systemic risk and fostering deeper structural reform on the financial supply side.

Keywords: Digital Inclusive Finance, Small and Medium-sized enterprises, Leverage Ratios

1. Introduction

Chinese debt and leverage have increased since the 2008 financial crisis. China's macro leverage ratio is high globally, with non-financial firms dominating. State-owned enterprises (SOEs) can get cheaper financing from traditional bank credit, while SMEs and private enterprises, which drive China's economic growth, face difficult and expensive financing and blocked financing channels[1]. China's digital inclusive finance has grown rapidly since the Central Economic Work Conference in 2016 named "deleveraging" as a priority structural reform task and the G20 Summit advocated "digital inclusive finance" in the same year. Digital inclusive finance has provided a new financing channel for private enterprises and SMEs that have been excluded from traditional financial services, meeting their diverse financing needs and increasing real economy financial support with lower loan thresholds, more diversified credit products, and faster lending speeds.

Previous studies have concentrated on how digital financial inclusion affects traditional financial markets as well as overall economic activity. Digital finance has increased residents' spending, consumer formal credit demand, and low-income rural household incomes, which has had diverse effects on different regions and income groups in China. It also measures digital inclusive finance development. The Digital Finance Research Centre of Peking University has compiled a digital finance index of Chinese provinces, cities, and counties from 2011 to 2021 using a huge amount of microdata, which is illustrate the development of various forms of digital finance in China over a long time span[2] and provides the data basis for Several researchers have examined how digital inclusive finance affects corporate leverage. Tang et al. (2020)[3] found that digital inclusive finance can effectively reduce corporate leverage; and Lin et al.(2021)[1] noted that digital inclusive finance has a significant negative impact on the total corporate leverage rate, in which the private sector and high-tech enterprises are more dependent on credit.

The above literature provides theoretical support for the study of corporate leverage's impact on digital financial inclusion, but because DFI's development is still young, the academic community is unclear about its role in enterprises with different characteristics and its impact on SMEs, which are key to China's economic development. Contributions of this paper include: First, this research examines how digital inclusive finance development affects SME leverage and business ownership and life cycle heterogeneity. Second, it extensively examines how digital inclusive finance affects SMEs' cash flow and financing channels and leverage ratios. Third, this paper shows that digital inclusive finance reduces

corporate debt risk and identifies a new transmission mechanism that affects corporate leverage, which can help prevent systemic risk and deepen financial supply side structural reform.

2. Theoretical analysis and research hypothesis

Information asymmetry theory states that investors are constrained by market position and information availability, whereas investors have a large information asymmetry. Asymmetry in information produces various company finance problems[4]. SMEs' imperfect hard information, such as limited scale, insufficient financial information, a small number of collateralisable assets, and few high-quality assets, worsens the information asymmetry between them and traditional financial institutions, making financing difficult and expensive. Big data, artificial intelligence, and other new information retrieval and analysis technologies allow digital financial institutions to fully explore borrowers' network behavior, transaction records, and other soft information in addition to hard information, reducing information asymmetry between borrowers and lenders. It leverages non-financial hard and soft data to make loan decisions, speeding up credit approval, lowering credit financing costs, and increasing money turnover for SMEs that couldn't use traditional financial institutions.Fuster et al. (2019)[5] observed that the digital financial loan model had a faster loan approval speed and lower loan default rate than traditional lenders, minimizing borrower-lender friction.

In addition, most of the loans from digital financial institutions are currently in the form of online loans and have a maturity of less than one year, so credit from digital financial institutions is short-term debt from a financial accounting perspective. Short-term debt brings about sufficient cash flow and liquid assets of the firm. If the firm can use the debt funds efficiently and convert them into effective assets and operating profit, it will be able to make itself less leveraged.

China's traditional financial system is centred on banks, whose credit business is dominated by medium- and long-term loans and mortgages. When SMEs are faced with digital inclusive finance, which offers lower loan thresholds and faster disbursement speeds, they will reduce their demand for long-term loans and adjust their own capital structure to reduce the proportion of long-term debt and convert it into rolling short-term liabilities, which will enhance their liquidity and create higher economic profits. Based on the above analysis, this paper proposes the hypothesis:

H_1: Increased levels of development of digital inclusive finance in firms' locations will reduce firms' own leverage.

3. Research design

3.1 Sample selection and data sources

In this paper, the data of the original SME board listed companies from 2011-2021 are used as the initial sample, and the data are processed as follows: (1) ST, *ST, and PT companies are excluded; (2) companies in the financial industry are excluded; (3) companies with missing data are excluded; ultimately, a total of 24,769 pieces of data are obtained. Among them, all company-level characteristic variables are from the Cathay Pacific database (CSMAR), and the digital financial inclusion index is from the Digital Finance Research Centre of Peking University. In addition, all continuous variables were Winsorised at 1% and 99% quantile to avoid the effect of extreme values.

3.2 Variable Definition

3.2.1 Explained variable

This paper measures the level of leverage ratio of a firm in terms of its gearing ratio (Lev). A higher gearing ratio implies a higher leverage ratio of the firm.

3.2.2 Explanatory variables

In this paper, the level of digital financial inclusion development is measured by the logarithm of the Peking University Digital Inclusion Index ($lnindex$).

3.2.3 Controlled Variables

In this paper, firm size ($Size$), total asset turnover (ATO), fixed asset ratio ($Fixed$), growth rate of operating income ($Growth$), Tobin's Q ($TobinQ$), book-to-market ratio (BM), and nature of ownership

(SOE) are selected as control variables, and year and industry dummies are added to control for time and industry effects. Specific variables are defined as shown in Table 1.

Table 1: Variable Definition

Variable Type	Variable Symbol	Variable Description
Explained variable	Lev	Total liabilities at end of period/total assets at end of period
Explanatory Variables	$lnindex$	Logarithm of the overall digital financial inclusion index
Control Variables	$Size$	Logarithms of Total assets of the enterprise at the end of the period
	ATO	Operating income/total assets
	$Fixed$	Total fixed assets at the end of the period / total assets at the end of the period
	$Growth$	(Operating income at the end of the current period - previous period) / previous period
	$TobinQ$	Market Value/Total Assets
	BM	Book value/total market value
	SOE	1 for state-owned, 0 for non-state-owned
	$Year$	Year dummy variable
	Ind	Industry dummy variable

3.3 Model Setting

The paper is analysed by means of multiple linear regression and robust standard errors to construct model (1) in order to explore the relationship between the degree of digital financial inclusion development in a firm's location and its own leverage ratio.

$$Lev_{i,t} = \beta_0 + \beta_1 \times lnindex_{i,t} + \sum Controls_{i,t} + \gamma_k + \lambda_t + \varepsilon_{i,t} \# \tag{1}$$

Where $Lev_{i,t}$ is the explanatory variable corporate leverage ratio, $lnindex_{i,t}$ is the total digital financial inclusion index of the location of the explanatory variable corporate; $\sum Controls_{i,t}$ represents the control variables, $\varepsilon_{i,t}$ is the random disturbance term, and γ_k and λ_t are the industry and time fixed effects, respectively. Where i and t represent individual and time, respectively. When beta1 is significantly negative, it indicates that the accompanying increase in the level of digital financial inclusion in the location of the enterprise will reduce the enterprise leverage ratio; conversely, it indicates that the accompanying increase in the level *of* digital financial inclusion in the location of the enterprise will increase the enterprise leverage ratio.

4. Empirical Analysis

4.1 Descriptive Statistics

Table 2: Descriptive Statistics

Variable	Obs	Mean	Sd	Min	Max
Lev	24769	0.400	0.202	0.031	0.925
lnindex	24769	5.537	0.537	2.786	6.129
Size	24769	22.09	1.252	19.52	26.43
ATO	24769	0.643	0.418	0.0530	2.902
Fixed	24769	0.203	0.151	0.00200	0.725
Growth	24769	0.180	0.399	-0.660	4.330
TobinQ	24769	2.091	1.387	0.802	17.73
SOE	24769	0.279	0.449	0	1
BM	24769	0.959	1.131	0.0510	10.14

The descriptive statistics of the main variables are shown in Table 2.From Table 2, it can be seen that the average leverage ratio of enterprises is 0.4, with the highest value of 0.925, the lowest value of 0.031, and the standard deviation of 0.202, indicating that the leverage ratio of listed SMEs in China is more

dispersed in distribution. The average value of the logarithm of the total digital inclusive finance index of the enterprise location is 5.537, the highest value is 6.129, the lowest value is 2.768, and the standard deviation is 0.537, which indicates that the average level of development of China's digital inclusive finance is higher, and that there is a difference in the development of digital inclusive finance in the location of the enterprise.

4.2 Baseline Regression

Table 3 reports the results of the benchmark regression between own leverage ratio and the degree of digital financial inclusion development in the firm's location. As can be seen from the results: the regression coefficient is -0.066 when only time and industry fixed effects are added, and the regression coefficient is -0.052 when control variables are further added, and both of them are significant at the 1% level. It indicates that the development of digital inclusive finance can significantly reduce the total leverage ratio of SMEs, which is consistent with the expectation of this paper, and hypothesis H_1 is verified.

Table 3: Baseline Regression Result

VARIABLES	(1) Lev	(2) Lev
lnindex	-0.066***	-0.052***
	(-4.59)	(-4.20)
Size	-	0.078***
	-	(17.56)
ATO	-	0.042***
	-	(5.48)
Fixed	-	0.194***
	-	(9.61)
Growth	-	0.001
	-	(0.25)
TobinQ	-	0.007***
	-	(4.74)
SOE	-	0.030***
	-	(2.94)
BM	-	0.024***
	-	(9.34)
Constant	0.612***	-1.212***
	(10.77)	(-11.21)
Observations	24,769	24,769
Adjusted R-squared	0.070	0.200
Year FE	YES	YES
Individual FE	YES	YES

4.3 Robustness Test

4.3.1 Adding control variables

The paper adds new control variables management shareholding ($Mshare$), institutional investor shareholding ($Inst$), and number of directors ($Board$). Column (1) of Table 4 reports the regression results, which show that firms' leverage ratios remain negatively correlated with the level of digital financial inclusion in the firm's location at the 1 per cent level, which is consistent with the results of the baseline regression.

4.3.2 Replacement of the explanatory variable

In this paper, two sub-indicators under the total index: the breadth of digital financial inclusion coverage and the depth of digital financial use are selected as explanatory variables to be re-run in the regression. The regression results are reported in columns (2) and (3) of Table 4. After replacing the explanatory variables, the regression coefficients of the sub-indicators and the corporate leverage ratio are still significantly negatively correlated at the 1 per cent level, verifying the stability of the baseline regression.

4.3.3 One period lag of the explanatory variable

In this paper, the explanatory variables are lagged by one period and then regressed, and column (4) of Table 4 of the regression results shows that the level of digital financial inclusion development is significantly negatively correlated with the leverage ratio to the extent of 1 per cent, which verifies the stability of the benchmark regression.

4.3.4 PSM

In order to avoid selectivity bias in the sample, this paper adopts 1:3 nearest-neighbour matching and kernel matching methods. Firm size, return on total assets, fixed asset ratio, operating income growth level, book-to-market ratio, Tobin's Q and nature of ownership are selected as matching variables for the 1:3 matching and passed the balance test. Regression tests are conducted on the new samples after matching and Table 4 reports the regression results, with column (5) being the nearest neighbour matching method and column (6) being the kernel matching method. The results show that the estimated coefficients of the level of digital financial inclusion development in the location of the firms and their leverage ratios remain significantly negative, and the conclusions are robust.

Table 4: Robustness Test Regression Results

	(1) Add Control variables	(2) Change Explanatory Variable	(3) Change Explanatory Variable	(4) Lag For One Year	(5) PSM nearest neighbor matching	(6) PSM kernel matching
VARIABLES	Lev	Lev	Lev	Lev	Lev	Lev
lnindex	-0.047***	-	-	-0.049***	-0.056***	-0.052***
	(-3.85)	-	-	(-4.05)	(-4.22)	(-4.21)
lncover	-	-0.024***	-	-	-	-
	-	(-3.89)	-	-	-	-
lndep	-	-	-0.041***	-	-	-
	-	-	(-2.97)	-	-	-
Constant	-1.120***	-1.328***	-1.249***	-1.080***	-1.199***	-1.213***
	(-10.37)	(-13.50)	(-10.94)	(-9.72)	(-10.59)	(-11.24)
Observations	24,769	24,769	24,769	20,740	21,600	24,743
R-squared	0.208	0.200	0.199	0.171	0.203	0.200
Controls	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Individual FE	YES	YES	YES	YES	YES	YES

5. Further Analysis

5.1 Heterogeneity Aanalysis

5.1.1 Heterogeneity analysis based on business ownership

This paper tests for heterogeneity by categorising SMEs into state-owned and non-state-owned according to ownership.In columns (1) (2) of Table 5, the digital financial inclusion index and corporate leverage ratio are considerably negative at 1% in non-state-owned firms but not in state-owned enterprises. This may be because state-owned enterprises have traditional finance-based service channels and only use digital inclusive finance as auxiliary financing, while non-state-owned enterprises have fewer high-quality assets and are not closely related to traditional financial channels, so they must rely more on it with lower financing thresholds, reflecting its supportive role. Digital inclusive finance's assistance for non-state enterprises and inclusive value is completely realized.

5.1.2 Heterogeneity analysis based on firm life cycle

Based on the division of the firm life cycle, this article divides SMEs into three stages: "growth stage,""maturity stage," and "decline stage" based on their cash flow situation. Columns (3) (4) and (5) of Table 5 show the test results: firms in the maturity stage have significantly negative regression coefficients of digital financial inclusion development in their location, while firms in the growth and decline stages have negative but not significant coefficients. Digital financial inclusion in SMEs' locations affects maturity but not the other two phases. Digital finance is inclusive, but many financial institutions still avoid lending to growth and decline enterprises since their profitability and cash flow

are unstable and their futures are riskier than mature organizations'. Mature enterprises can deleverage with digital inclusive finance because to their consistent cash flow, company plan, and market profitability.

Table 5: Heterogeneity Aanalysis regression results

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Non-state-owned	State-owned	Growth Stage	Maturity Stage	Decline Stage
lnindex	-0.077***	0.014	-0.022	-0.049***	-0.062
	(-4.44)	(0.81)	(-0.76)	(-3.60)	(-1.54)
Constant	-0.830***	-1.306***	-1.486***	-1.253***	-1.379***
	(-6.32)	(-6.76)	(-5.21)	(-10.86)	(-4.73)
Observations	17,830	6,913	2,936	17,096	4,629
R-squared	0.255	0.176	0.274	0.206	0.173
Number of id	2,691	924	1,472	3,292	2,112
Controls	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Individual FE	YES	YES	YES	YES	YES

5.2 Mechanism analysis

5.2.1 Cash flow-based transmission mechanism

Cash flow helps firms survive and expand by preserving capital liquidity and increasing profits. Operating earnings are higher for cash-rich companies. Digital inclusive finance boosts credit fund issuance efficiency, increasing company liquidity and operating profits, lowering passive debt financing demand and deleveraging. This paper used money funds and trading financial assets as a percentage of total assets to estimate operating cash flow using multiple linear regressions. In column (1) of Table 6, the regression coefficient of cash on the development level of digital inclusive finance is positive and significant at the 1% level, indicating that developing digital inclusive finance in the enterprise's location can increase its cash stock and reduce its leverage ratio.

5.2.2 Long-term liability-based transmission mechanism

Credit business in China is characterized by medium- and long-term loans and mortgages, while banks dominate the financial sector. In contrast, the digital inclusive financial system has fast approval, efficient lending, and low-threshold financing. Such features will improve corporate financial services, reduce long-term loan demand, and increase short-term loan demand, indirectly lowering company leverage ratios and accomplishing deleveraging. Through the test of this paper, the results in column (2) of Table 6 show that the regression coefficient of the share of long-term loans on the digital financial inclusion index is negative and significant at the 1 per cent level. This suggests that the development of digital financial inclusion at the location of firms can reduce the overall leverage ratio by reducing the proportion of long-term liabilities. This may be due to the fact that firms have access to a wider range of financing sources, reducing the need for traditional medium- and long-term loans.

Table 6: Mechanism analysis regression results

	(1)	(2)
VARIABLES	Cash Flow	Long-term liaility
lnindex	0.101***	-0.034***
	(7.97)	(-5.10)
Constant	0.015	-0.649***
	(0.29)	(-12.07)
Observations	24,769	20,448
R-squared	0.181	0.131
Controls	YES	YES
Year FE	YES	YES
Industry FE	YES	YES

6. Conclusions

In recent years, Chinese SMEs have faced debt risk, financing issues, and financing costs. Digital inclusive finance is seen as a solution. This research examines how digital inclusive finance development affects SMEs' leverage ratios using a 2011–2021 sample of former SME board listed enterprises. The results of the study show that: the development of digital financial inclusion has a significant negative impact on the leverage ratio of enterprises; the development of digital financial inclusion can reduce its own leverage ratio by improving the cash flow of enterprises and lowering the long-term debt ratio; the effect of the development of digital financial inclusion on the reduction of leverage ratio is more obvious in the non-state-owned enterprises and the enterprises in the "maturity period".

The paper is of policy significance for the reasons outlined below: First, digital inclusive finance minimizes company leverage and improves "deleveraging" and "stable growth" policies. Build digital network infrastructure and strengthen digital inclusive financial financing to replace traditional credit instruments and lower company leverage ratios. Second, technology should speed digital transformation in traditional financial institutions. Small and medium-sized firms can benefit from digital inclusive financial institutions' complete exploration of borrowers' non-financial hard and behavioural soft information utilizing big data, artificial intelligence, and other technologies to reduce the lending barrier and speed up approval Traditional banks that use enterprise data to make medium- and long-term loans cannot meet market demand. Finally, established financial institutions should lend to non-state-owned enterprises based on their financial standing, not ownership or politics. This would benefit private SMEs and China's economy.

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