The Impact of Digital Financial Inclusion on Financing Constraints: Evidence from China's A-share Listed Companies

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Abstract. This study examines the impact of digital financial inclusion on financing constraints encountered by corporates, using all of China's A-share listed companies from 2011 to 2020 as the research sample. This study finds that the development of digital inclusive finance has a positive effect on all enterprises in alleviating financing constraints. Through the heterogeneity test, we find that digital inclusive finance is more effective in alleviating financing constraints for state-controlled enterprises, large-scale enterprises, enterprises in developed cities and enterprises in the technology industry. The mechanism analysis finds that digital inclusive finance alleviates corporate financing constraints by alleviating corporate information asymmetry. This study inspires enterprises to alleviate financing constraints.

Keywords: digital financial inclusion; financing constraints; information asymmetry.

1. Introduction

The difficulty and high cost of financing for small and medium enterprises (SMEs) has been a common concern in society, as SMEs face greater financing constraints, which in turn leads to greater pressure on their innovation and development. SMEs constitute the majority of enterprises in most countries. Their survival, employment growth strategies, productivity, and innovation depend on access to financial resources to a large extent[1].

To address this problem, the United Nations first introduced the concept of Digital Financial Inclusion in 2005, which refers to the provision of appropriate and effective financial services at an affordable cost to all walks of life, with vulnerable groups such as micro and small enterprises, farmers, and low-income urban populations as its priority targets. Since 2006, inclusive finance has rapidly spread in China, and to stimulate the economy, the government has enacted a series of regulations and policies to support the development of SMEs, purify the environment for the development of SMEs, and create a standardized and orderly financial market. In this process, digital financial services (DFSs) have contributed to promoting inclusive finance development in China [2].

To verify that the appearance and development of digital inclusive finance have played a positive role in promoting all enterprises, this study takes all A-share listed companies from 2011 to 2020 as the research sample, referring to Fazzari et al. [3], Kaplan and Zingales [4], Lamont et al.[5], Whited and Wu [6], Hadlock and Pierce [7]. For the metrics of financing constraints, this study constructs two-way fixed linear regression models. Moreover, this study refers to the illiquidity indicator constructed by Amihud [8] and Pastor & Stambaugh [9] as the variable of information asymmetry degree, and the mechanism test proves that digital financial inclusion alleviates the financing constraint by alleviating the information asymmetry degree of enterprises. In terms of the robustness test, this study verifies the reliability of the paper's findings by replacing the core independent variables and the core independent variables.

The possible contributions of this study are as follows: First, this study verifies the positive effect of digital inclusion finance on alleviating the financing constraints of enterprises and provides policy recommendations based on the findings of this study. Second, this study complements the asymmetry study with the mechanism of "digital inclusive finance-information asymmetry-financing constraint".

2. Literature Review

The issue of corporate financing constraints has been extensively studied by academics. Recent studies found that financing constraints impede corporate investment activities [10]. External financing is subject to information disclosure and irregular financial statements, lack of collateral, poor operating ability, less information disclosure, information asymmetry [11] and many other factors.

Digital inclusive finance, as a new inclusive financial model, is relatively less studied in China. The existing literature mainly focuses on the role of digital inclusive finance in upgrading the consumption structure of rural households in China [12], reducing carbon intensity by optimizing the industrial structure and promoting green technology [13], rural financial ecology and integrating rural tertiary industry, urban innovation [14], and entrepreneurship among rural residents. Scholars' findings suggest that the implementation and development of inclusive finance can provide stable financial support for the sustainable growth of SMEs in the context of quality economic development in China.

Some scholars use data and empirical methods to analyze the impact of digital inclusive finance on SMEs' technological innovation and examine the effect of financing constraints as the mediators between digital finance and firms' innovative activities [15]. However, this study finds that the existing literature is mostly based on SMEs when verifying how digital inclusive finance affects corporate financing constraints. this study believes that digital inclusion finance is a social inclusive policy and should be applied to all enterprises. In addition, the existing literature has less analysis on the mechanism of digital inclusive finance to alleviate corporate financing constraints. The study proposes the hypothesis that alleviating the information asymmetry problem is its mechanism, which will be verified later.

3. Methodology

3.1 Data

In this study, the digital financial inclusion index is obtained from the Digital Finance Research Center of Peking University[16], the firm-level data is obtained from the CSMAR database, and the variables are selected for the time range from 2011 to 2020, and they have gone through following processes. (1) Excluding the data of listed companies in the financial industry; (2) Excluding the data of the current year of the specially treated enterprises; (3) Excluding the data of listed companies with incomplete financial data in the sample period year; (4) To eliminate the influence of extreme values, this study uses Winsorize's method to winsorize data below 1% and above 99% of the continuous variables of the sample. After merging the digital financial inclusion index with the processed company financial data, 91108 valid samples were obtained in this study. (5) To make the results more obvious and easier to express, the independent variables and control variables are shrunk 1000 times in this study, and this process does not affect the significance level of the regression results.

3.2 Variables

a. Dependent Variables

In terms of measuring financing constraints, the academic community hasn't reached an agreement.

The most common KZ index is currently proposed by Lamont et al. [5] after updating and improving the model, which contains factors such as (CashFlow/Asset), (Debt/Asset), Tobin's Q, (Dividends/Asset) and (Cash/Asset). A larger KZ index represents the severe financial constraints of the firm. The specific construction equation is as follows.

$$KZ = -1.002\text{CashFlow}/\text{Asset} + 0.283Q + 3.139\text{Debt}/\text{Asset}$$
$$- 39.368\text{Dividends}/\text{Asset} - 1.315\text{Cash}/\text{Asset} \quad\quad (1)$$

In addition, a common measure of financing constraint is the Size Age Index, which is proposed by Hadlock and Pierce [7], who obtained the SA index by combining the firm's size (Size) and time to market (Age). The greater the absolute value of SA index, the more serious the financing constraints faced by listed companies. The index is calculated by the following formula.

$$SA = -0.0737\text{Size} + 0.043\text{Size}^2 - 0.04\text{Age} \quad (2)$$

Since this index can avoid the problem of endogeneity to some extent, it has become one of the preferred methods by most scholars. In this study, when using the SA index for robustness testing, the variable LSA, which takes the logarithm after its absolute value, is used as a measure of financing constraints because its logarithmic operation can observe the relative percentage change.

Whited and Wu [6] proposed the Whited-Wu (WW) method, which selects six indicators: cash flow ratio ($CF_{i,t}$), debt ratio ($LEV_{i,t}$), total assets ($LnSize_{i,t}$), company's main business revenue growth rate ($SG_{i,t}$), industry main business growth rate ($ISG_{i,t}$) and dividend payment dummy variable ($DIVdummy_{i,t}$), to form a primary linear equation as a proxy variable for external financing constraints. Among them, the dummy variable is taken as 1 when dividends are paid. The following is the formula

$$WW = -0.091\text{CF} - 0.062\text{DIVdummy} + 0.021\text{LEV} - 0.044\text{Size} + 0.102\text{ISG}$$
$$- 0.035\text{SG} \quad\quad\quad (3)$$

Another indicator that is widely used in academic circle to measure financing constraints is the FC index [7], which is listed as follows.

$$P(QUFC = 1 \text{ or } 0|Z_{i,t}) = \frac{e^{Z_{i,t}}}{1 + e^{Z_{i,t}}} \quad\quad (4)$$

where：

$$Z_{i,t} = \alpha_0 + \alpha_1 \text{size}_{i,t} + \alpha_2 \text{lev}_{i,t} + \alpha_3 (\frac{\text{CashDiv}}{\text{Asset}})_{i,t} + \alpha_4 MB_{i,t} + \alpha_5 (\frac{\text{NWC}}{\text{Asset}})_{i,t} + \alpha_6 (\frac{\text{EBIT}}{\text{Asset}})_{i,t} \quad (5)$$

$size_{i,t}$ represents the scale of the firm's assets and the natural logarithm of total assets(Asset); $lev_{i,t}$ represents the firm's financial leverage (Debt); Cash Div is the firm's cash dividends paid in the year; $MB_{i,t}$ is the firm's market-to-book ratio (market value/book value); NWC is the firm's net working capital (working capital-money capital – short-term investments); and EBIT is earnings before interest and tax.

It is verified that the KZ, WW, and SA indices do not differ in their measures of financing constraints, but the KZ index has a very large measurement error due to Tobin's Q value, and then causes the KZ index to have an error in measuring financing constraints [6]. The WW index, which excludes the n's Q value and includes the external industry characteristics of the enterprise, so the measurement results will be closer to the real level. In addition, the SA index is not as comprehensive as the WW index because the only factors that affect corporate finance are the size of the company and the number of years of establishment. Therefore, this study uses the WW index to measure the level of financing constraints of SMEs, and the SA index, KZ index, and FC index are used for robustness testing.

b. Independent Variables

In terms of measuring inclusive finance, this study adopts the inclusive finance index compiled by the Digital Finance Research Center of Peking University to measure the development level of each region in this area [16]. It constructs a digital financial inclusion index system from three dimensions, including the breadth of digital financial coverage, the depth of digital financial use, and the degree of digitalization of inclusive finance. When the index ' s value is higher, the development level of digital inclusive finance is higher.

This study uses the total index of inclusive finance as the independent variable for the benchmark regression, and its three sub-indices $Coverage\_breadth_{i,t}$, $Usage\_depth_{i,t}$, and $Digitization\_level_{i,t}$ as the independent variables for the robustness test of this study.

    c. Control Variables

In addition to the above-mentioned independent and dependent variables, this study controls capital structure (ELR), operating capacity (TRCA), Debt paying ability (CA), enterprise growth (GROW) in view of the method from Huang (2021). In addition, year and region variables are set in the research design of this study to control year-fixed effects (Year) and industry-fixed effects (Industry), respectively. The variables used in this study are summarized and calculated as shown in Table 1.

Table 1.   Summary of Variables

Type	Name	Symbol	Definition
Dependent Variables	Financing Constraints	WW	Proxy Variable of Financing Constraints (Calculations described in function (1)(2)(3)(4)(5))
		LSA	
		KZ	
		FC	
Independent Variables	Digital Inclusive Finance	DIF	Digital Inclusive Finance Index of Peking University
	Coverage_breadth	CB	China Digital Inclusive Financial Coverage Index
	Usage_depth	UD	China Digital Inclusive Financial Depth Index
	Digitization_level	DL	The level of digital development
Control Variable	Capital structure	ELR	Equity Liability Ratio = Total owner's equity / Total liabilities
	Operating capacity	TRCA	The turnover rate of current assets = Net income from main business /
	Debt paying ability	CA	Cash ratio = Ending balance of cash and cash equivalents /Current
	Enterprise growth	GROW	The growth rate of main business income = (Current main business
	Fixed Effect	Year	Year dummy variables
		Industry	Industry dummy variables

3.3 Model

In this study, we want to verify the relationship between digital financial inclusion and firm financing constraints, so we construct the following reference regression model.

$$WW_{i,t} = \beta_0 + \beta_1 DIF_{i,t-1} + \beta_2 ELR_{i,t-1} + \beta_3 TRCA_{i,t-1} + \beta_4 CA_{i,t-1} + \beta_5 GROW_{i,t-1} + \rho_{t-1} + \sigma_i + \varepsilon_{i,t-1} \qquad (6)$$

The dependent variable Financing Constraints ($WW_{i,t}$), the independent variable Digital Inclusive Finance ($DIF_{i,t-1}$), and the control variables are included in equation (4). In addition, Year

fixed effect and Industry fixed effect are represented as ρ_{t-1} and σ_i, respectively in order to control possible time trends and industrial differences in each variable. $\varepsilon_{i,t-1}$ is the error term. To avoid the unreliable results caused by endogeneity to some extent, this study treats the independent variables with a one-period lag. This study expects that digital financial inclusion will alleviate the financing constraint of companies, so the coefficient of $DIF_{i,t-1}$ which is β_1 are expected to be significantly negative.

4.   Empirical Results

4.1 Descriptive Statistics

Table 2 presents the descriptive statistics of the main variables in This study. From the statistics of the WW variables, the maximum values are negative, indicating that the WW index has no positive value overall. From the statistical results of Digital Inclusive Finance (DIF) in the table, the standard deviation is 0.069, and the minimum and maximum values are 0.021 and 0.322, respectively. This indicates that the development level of digital inclusive finance in China varies greatly from year to year and from industry to industry, reflecting the reasonableness of including year and industry-fixed effects in this study's model.

Table 2.   Descriptive Statistics of Variables

VAR	N	Mean	Sd	Min	Max
WW	91,108	-1.040	0.070	-1.253	-0.878
LSA	91,108	1.326	0.067	1.106	1.478
KZ	91,108	1.475	1.983	-4.730	6.071
FC	91,108	0.400	0.277	0.003	0.928
DIF	91,108	0.196	0.069	0.052	0.321
Coverage_breadth	91,108	0.196	0.065	0.050	0.311
Usage_depth	91,108	0.193	0.073	0.053	0.332
Digitization_level	91,108	0.204	0.087	0.019	0.336
ELR	91,108	0.001	0.001	0.000	0.009
TRCA	91,108	0.001	0.001	0.000	0.005
CA	91,108	0.000	0.001	0.000	0.003
GROW	91,108	0.000	0.001	-0.001	0.008

4.2 Correlation Analysis

The correlation analysis was performed for all variables. The correlation coefficients among the dependent variables WW, KZ, and LSA are small, which shows that these three indicators measure the financing constraints from three aspects and are more conducive to verifying that the results of this study are robust. In the meanwhile, the variables in this study is less likely to cause multicollinearity problems in the regression results. (Due to length, the results of correlation analysis are not listed in the text. If necessary it can be requested from the author.)

4.3 Basis Regression

The regressions are based on the baseline model presented above and have been adjusted for heteroskedasticity of the standard errors. Table 4 shows that the coefficient in equation (6) is significantly negative, indicating that digital inclusive finance significantly reduces the cost of corporate financing and alleviates the financing constraint. From column (3) of Table 3, when the level of digital inclusive finance is increased by 1, the degree of financing constraint is correspondingly reduced by 0.271.

To investigate the reasons: First, the generation and development of digital inclusive finance can reduce the threshold of enterprise financing. Based on traditional financial services, digital inclusive finance innovates traditional financial services and products through the advantages of application services and scenarios, expanding the breadth and depth of financial services, effectively reducing the financing barriers faced by enterprises in the financing process, which is conducive to their healthy and sustainable development, which in turn is conducive to the healthy development of the market economy, and the supply side of the domestic cycle is fully ensured. Secondly, digital inclusive finance reduces the information asymmetry between the supply and demand sides and promotes the diversity of financial institutions' services. In the era of digital inclusive finance, the digital economy plays a very important role, adding new content to traditional financial credit services. First, traditional financial institutions have launched mobile banking and other businesses, and business information has become more transparent, which is conducive to reducing the cost of activities between banks and SMEs, and also broadening the scope of business through digital technology; the second, digital economy has also contributed to the diversification of financial lending services, and with the gradual increase of online lending platforms, enterprises can effectively reduce their search costs, and they can choose their lenders according to the actual situation.

Table 3.   The Impact of Digital Financial Inclusion

on the Financing Constraints

Variables	Dep Var = WW		
	(1)	(2)	(3)
DIF	-0.204***	-0.191***	-0.271***
	(0.003)	(0.003)	(0.011)
Cols	NO	YES	YES
Industry Effects	NO	NO	YES
Year Effects	NO	NO	YES
Observations	91,108	91,108	91,108
Adj_R-squared	0.004	0.140	0.217
Note: The standard error after adjusting heteroscedasticity of the corresponding regression coefficient is shown in brackets. ***, **, and, * denote rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively.			

4.4 Heterogeneity Test

The size of an enterprise's financing constraint is related to the nature of its equity. For state-controlled enterprises, their debt repayment behavior is both supervised and supported by the state, so their repayment ability is more likely to be trusted by banks and other institutions, which in turn can alleviate their financing constraints. To exclude the effect of the nature of equity on the empirical results, this study divides the sample into a state-controlled group and a non-state-controlled group by the nature of the actual controllers. If it is state-controlled, we designed that gov=1 and ungov=0 which is contrary to the non-state-controlled group. And to explore which equity nature of the firms with digital inclusion finance has a more significant effect on reducing financing constraints, this study constructs the interaction term of digital inclusion finance and equity nature (DIF_gov) and uses equation (7) for regression.

$$WW_{i,t} = \beta_0 + \beta_1 \text{Interaction}_{i,t-1} + \beta_2 DIF_{i,t-1} + \beta_3 ELR_{i,t-1} + \beta_4 TRCA_{i,t-1} + \beta_5 CA_{i,t-1}$$
$$+ \beta_6 GROW_{i,t-1} + \rho_{t-1} + \sigma_i + \varepsilon_{i,t-1} \qquad (7)$$

The size of firms' financing constraints is related to their regional characteristics. Scholars have found that the alleviating effect of developing digital inclusive finance on SMEs' financial constraints may be weaker in regions with higher levels of financial development. To verify whether this conclusion applies to all enterprises, this study first divides the cities to which enterprises belong into two groups according to their level of development, using the GDP

development level to measure the level of urban development, with regions above the GDP mean being those with higher levels of development, and those below the GDP mean are less developed areas. If it is in higher developed areas, we designed that dev=1 and undev=0 which is contrary in less developed areas. Then the interaction term (DIF_undev) between digital inclusive finance and regional development degree is constructed and regressed using equation (7).

The size of a firm's financing constraint is related to its size. For large-scale enterprises, the ability to repay financing is stronger in their financing process because they face less risk of bankruptcy. Therefore, compared to small-scale firms, large-scale firms have lower financing constraints. In this study, size is measured based on the natural logarithm of total assets, firms above its mean are larger and those below its mean are smaller, divided into larger and smaller firms. If it is larger firms, we designed that big=1 and small=0 which is contrary in smaller firms. In addition, to test the magnitude of digital inclusive finance in alleviating the financing costs of firms of different sizes, this study constructs the cross-product term of digital inclusive finance and firm size (DIF_big) and uses equation (7) for regression testing.

The size of enterprise financing constraints is related to industry characteristics. Digital inclusive finance has developed rapidly based on the development of the "digital economy", and its process has eased the financing constraints of enterprises due to the use of e-commerce business platforms and the introduction of digital talents. To exclude the advantages of technology-based industries, this study classifies industries based on the 2012 Revised Industry Classification Guidelines for Listed Companies by the China Securities Regulatory Commission, in which scientific research and technological services (M) are technology-based enterprises and the rest are non-technology-based industries. If it is a technology-based enterprise, we designed sci=1 and unsci=0 which is contrary to non-technology-based industries. Similarly, for technology-based and non-technology-based industries, the cross-product term (DIF_unsic) of digital inclusive finance and industry characteristics is constructed in this study, and the regression test is conducted using equation (7).

The results of the above heterogeneity tests are presented in Table 4.

Table 4.   The Results of the Heterogeneity Test

Variables	Dep Var = WW			
	Equity	City	Size	Industry
	(1)	(2)	(3)	(4)
	Compare	Compare	Compare	Compare
DIF	-0.251***	-0.149***	-0.092***	-0.101***
	(0.010)	(0.013)	(0.002)	(0.036)
Interaction	-0.121***	-0.035***	-0.365***	-0.170***
	(0.002)	(0.002)	(0.002)	(0.034)
Cols	YES	YES	YES	YES
Year Effects	YES	YES	YES	YES
Industry Effects	YES	YES	YES	YES
Observations	90,880	91,108	91,108	91,108
Adj_R-squared	0.246	0.219	0.463	0.218
Note: The standard error after adjusting heteroscedasticity of the corresponding regression coefficient is shown in brackets. ***, **, and, * denote rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively.				

Based on the results presented in Table 5, it can be concluded from the significantly negative coefficient of the cross-product term in column (1) that state-controlled enterprises receive more benefits from easing financing constraints than non-state-controlled enterprises in the face of new developments in digital inclusive finance. The possible reason is that state-controlled enterprises are more likely to absorb digital inclusive finance, and when they develop vigorously, state-owned

enterprises are more likely to be trusted by banking institutions and others due to their state-controlled nature. The significant negative coefficient of the cross-product term in column (2) shows that the effect of easing financing constraints is more significant in regions with higher levels of GDP development than in regions with lower levels of GDP development. The possible reasons for this are that regions with higher GDP development have more funds to promote digital inclusive finance, and people are more willing to accept digital inclusive finance than regions with lower GDP development, and thus its application is more widespread. Unlike most scholars who have studied the effect of digital inclusive finance on alleviating the financing constraints of SMEs, this study broadens the research sample to all A-share listed companies, and it is clear from the significant negative coefficient of the cross product in column (3) that larger companies benefit more from the alleviation of financing constraints in the face of the development of digital inclusive finance. In view of this phenomenon, this study argues that the reason why larger enterprises are larger is that their development trend is better, so banking institutions and people are generally more willing to trust them. From this perspective, the financing constraint of large-scale enterprises should be generally smaller than that of small-scale enterprises. However, due to its large size, it participates in large-scale investment and financing activities and most of them are long-term behaviors, the effect of digital financial inclusion on their financing constraints is more significant than that of small-scale enterprises.

The regression results in column (4) show that the effect of digital inclusive finance is more significant for non-technology industries. This phenomenon is consistent with the theory of diminishing marginal utility, as the effect of digital inclusion is much more significant for non-technology industries than for technology industries when they are first exposed to the digital economy and digital inclusion on a large scale.

4.5 Mechanisms

In previous studies, information asymmetry has been considered one of the important causes of financing constraints for firms [17][18][19]. In imperfect markets, information asymmetry manifests itself as adverse selection before the investment and financing process and as a moral hazard problem after that process. For the lender of funds, adverse selection means that investing in a more creditworthy, better-run, and more mature firm is undoubtedly a better choice, so the quality of information disclosed by the firm as the lender of funds becomes an important factor for the smoothness of the financing process. In addition, there is no perfect substitute between the firm's internal funds and external financing, with external funds bearing higher interest rates and loan collateral [17], so the problem of adverse selection becomes an important part of the firm's financing constraints [19].

Digital inclusive finance relies on the digital economy as a vehicle to inject more and more transparent opportunities into the financial market. First, the digitalization of the general environment of digital inclusive finance has facilitated the matching process between lenders and borrowers. Along with the rapid development of the Internet, digital inclusive finance can be developed based on digital platforms, and the sharing, transparency, and intelligence of information on the platforms become an important way to alleviate the problem of information asymmetry. Digital transaction behavior and payment behavior help to match better borrowers and lenders and facilitate the conclusion of transactions, thus alleviating financing constraints to a certain extent. Second, inclusiveness as one of the important features of digital inclusive finance provides more diversified opportunities for some enterprises. Digital inclusive finance significantly alleviates the financing constraints of SMEs because some SMEs have difficulty in gaining the trust of lenders due to their small size and are often accompanied by high loan interest rates and loan collateral, which negatively affects the development of SMEs. The emergence of digital inclusive finance makes the creditworthiness and transaction behavior of enterprises more transparent, which has a positive boosting effect on obtaining lower loan interest rates and loan collateral conditions, thus alleviating the financing constraints of enterprises and playing a virtuous circle effect on enterprise

development. Third, using depth as the most direct result of digital financial inclusion plays a positive role in overall socio-economic development. With the rapid development of inclusive finance, the financing process and development process of many enterprises have been supported by the inclusive finance policy, so the overall economic situation of the society is changing for the better, the trust between enterprises is improved, the problem of adverse selection problem is alleviated, and the financing constraints of all enterprises are positively alleviated.

In summary, digital inclusive finance can greatly solve the problem of information asymmetry between the supply and demand sides of funds, thus broadening the transaction dimension and reasonably dispersing risks, which can eventually effectively alleviate the financing constraint problem of enterprises.

To verify the above view, this study constructs the illiquidity ratio indicator ILL by referring to [8] and [9] method based on daily frequency transaction data to measure the degree of information asymmetry.

$$\text{ILL}_{it} = -\frac{1}{D_{it}} \sum_{k=1}^{D_{it}} \sqrt{\frac{|r_{it}(k)|}{V_{it}(k)}} \tag{8}$$

Since the less adverse selection problem, the more investment and financing behavior, and the essence of the investment and financing process, i.e., the trading process of stocks, the more transactions, the more liquid and the less illiquid the stocks are. Therefore, the mitigation of information asymmetry is reflected in the reduction of stock illiquidity.

In this study, we construct the model shown in equation (9) to verify the above view.

$$\text{ILL}_{i,t} = \beta_0 + \beta_1 \text{DIF}_{i,t-1} + \beta_2 \text{ELR}_{i,t-1} + \beta_3 \text{TRCA}_{i,t-1} + \beta_4 \text{CA}_{i,t-1} + \beta_5 \text{GROW}_{i,t-1} + \rho_{t-1} + \sigma_i + \varepsilon_{i,t-1} \tag{9}$$

Table 5.   The Impact of Digital Financial Inclusion

on the Information Asymmetry

Variables	Dep Var = ILL		
	(1)	(2)	(3)
DIF	-0.038***	-0.037***	-0.017***
	(0.000)	(0.000)	(0.001)
Cols	NO	YES	YES
Year Effects	NO	NO	YES
Industry Effects	NO	NO	YES
Observations	91,056	91,056	91,056
Adj_R-squared	0.114	0.124	0.320
Note: The standard error after adjusting heteroscedasticity of the corresponding regression coefficient is shown in brackets. ***, **, and, * denote rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively.			

Table 5 presents the regression results of the mechanism analysis, in which the regression coefficients of the independent variables are all significantly negative. From the results in column (3) of Table 5, when the level of digital financial inclusion increases by 1, enterprises' degree of information asymmetry decreases accordingly by 0.017, implying that digital financial inclusion significantly alleviates the information asymmetry problem, which in turn alleviates the financing constraints of enterprises, and the mechanism analysis establishes.

4.6 Robustness Test

To verify the robustness of the empirical results in this study, multiple regressions were conducted by replacing the independent and dependent variables.

$$\text{Dep}_{i,t} = \beta_0 + \beta_1 \text{InDep}_{i,t-1} + \beta_2 \text{ELR}_{i,t-1} + \beta_3 \text{TRCA}_{i,t-1} + \beta_4 \text{CA}_{i,t-1} + \beta_5 \text{GROW}_{i,t-1} + \rho_{t-1} + \sigma_i + \varepsilon_{i,t-1} \tag{10}$$

Among them, we use Ln(|SA|) index, KZ index and FC index to represent financial constraints respectively. Coverage_breadth, Usage_depth, and Digitization_level represent the level of digital financial inclusion development respectively, and the regression results are shown in Table 6 and Table 7 using equation (8).

Table 6.   Robustness Test - Part 1

Vars	Dep Var = WW			
	(1)	(2)	(3)	(4)
DIF	-0.271***			
	(0.011)			
Coverage_breadth		-0.202***		
		(0.008)		
Usage_depth			-0.196***	
			(0.009)	
Digitization_level				-0.045***
				(0.014)
Cols	YES	YES	YES	YES
Year Effects	YES	YES	YES	YES
Industry Effects	YES	YES	YES	YES
Observations	91,108	91,108	91,108	91,108
Adj_R-squared	0.0300	0.217	0.216	0.212
Note: The standard error after adjusting heteroscedasticity of the corresponding regression coefficient is shown in brackets. ***, **, and, * denote rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively.				

As seen from the results in Table 6, when the WW index is used to measure the financing constraint and the total digital inclusive finance index (DIF), digital financial coverage breadth (Coverage_breadth), digital financial usage depth (Usage_depth), and digitalization level of inclusive finance (Digitization_level) are used as independent variables, the coefficients are -0.271, -0.202, -0.196, and -0.045 respectively, all of which are significantly negative at the 1% level, reflecting the paper's view that digital financial inclusion can alleviate corporate financing constraints.

Table 7.   Robustness Test - Part 2

Dep Var	LSA	KZ	FC
	(1)	(2)	(3)
DIF	-0.389***	-0.744***	-0.239***
	(0.011)	(0.258)	(0.038)
Cols	YES	YES	YES
Year Effects	YES	YES	YES
Industry Effects	YES	YES	YES
Observations	91,108	91,108	91,108
Adj_R-squared	0.134	0.341	0.342
Note: The standard error after adjusting heteroscedasticity of the corresponding regression coefficient is shown in brackets. ***, **, and, * denote rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively.			

Table 7 shows the regression results of measuring financial constraints through LSA index, KZ index and FC index. core independent variables DIF are -0.389, -0.744, and -0.239, respectively, all of which are significantly negative at the 1% significance level. These results further prove that the empirical results of this study are very robust and the use of digital inclusive finance has played a significant role in alleviating the financing constraints of enterprises.

5.   Conclusion

This study examines the impact of digital inclusive finance policies on the financing constraint problem of enterprises in the context of digital inclusive finance policies. It is found that: firstly, digital inclusive finance plays a significant role in alleviating the financing constraint problem of enterprises. Secondly, the heterogeneity study finds that digital inclusive finance has a more significant effect on alleviating financing constraints for state-controlled enterprises, enterprises in cities with a higher level of development, larger enterprises, and enterprises in non-technology industries. In addition, this study innovatively expands the research sample to all A-share listed enterprises, verifying that the effect of digital inclusive finance on relieving financing constraints of large-scale enterprises is more significant.   Besides, through mechanism analysis, this study verifies that digital inclusive finance alleviates the information asymmetry problem of enterprises through its digitalization, universality, and depth, and thus alleviates the financing constraints of enterprises.

From the above analysis, this study provides insights for enterprises to alleviate financing constraints: First, enterprises can increase their trustworthiness in the lending process and improve their information disclosure by increasing the proportion of state-owned holdings. Second, enterprises can obtain superior development resources by developing their operations in more developed cities, and thus their financing constraints can be alleviated. Third, enterprises can introduce more technological elements in their business process to enhance their development efficiency, and at the same time alleviate their information asymmetry problems through digital platforms, which in turn can alleviate their financing constraints.

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