Research on the impact of digital inclusive finance on private enterprise's leverage level with financial constraint as a mediating variable

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Abstract. Along with the advent of the digital economy, digital inclusive finance has increasingly played an important role in alleviating the enterprises' financing difficulties and contributing to healthy economic development. This paper examines the effect, mediating mechanism and heterogeneity of digital inclusive finance on the leverage of private enterprises by empirically analyzing the private enterprises on the Shanghai Stock Exchange and Shenzhen Stock Exchange from 2011-2017. It shows that digital inclusive finance can significantly reduce the leverage level of private enterprises. Also, it can be achieved mainly through alleviating enterprises' financing constraints. The heterogeneity analysis shows that the dual effect of digital inclusive finance in alleviating financing constraints and reducing leverage level is more significant for large private enterprises and middle-western regions. In addition, the impact of digital inclusive finance on reducing short-term leverage is more significant compared to long-term leverage. Therefore, this paper enriches the research related to the impact of digital inclusive finance on enterprises at the micro level, and provides empirical evidence for promoting the development of digital inclusive finance and optimizing the financial supply system.

Keywords: Digital inclusive finance; Private enterprises; Leverage level; Financing constraints.

1. Introduction

Since 2008, China's macro leverage levels have risen rapidly, with the macro leverage even rising to 270.1% by year-end 2019. Under the continued promotion of deleveraging policies, the leverage of Chinese state-owned enterprises has declined, but the leverage of private enterprises has continued to rise . Private enterprises have long faced the difficulties of "expensive financing". They have to use leveraged financing but the high leverage brings high financial risks, which can easily lead to debt crises and capital market turmoil. In order to support the development of private enterprises and optimize their financing structure, it is necessary to promote financial supply-side reform.

In recent years, digital inclusive finance has developed rapidly, offering a new business model different from traditional finance, and according to the White Paper on the Development of China's Digital Economy, China's digital economy will reach 45.5 trillion yuan in 2021, with a nominal growth of 16.2% year-on-year and a proportion of 39.8% of GDP . Digital inclusive finance extends the scope of financial services, broadens financing channels and can, in theory, greatly optimize the leverage level of enterprises by alleviating financing constraints. In the face of the high leverage of private enterprises, it is worth exploring whether digital inclusive finance can ease the financing constraints of enterprises and reduce the leverage levels. Whether the effect of digital inclusive finance varies from size and region and whether there are different in effects on long-term and short-term leverage also should be explored.

The marginal contributions of this paper are as follows. First, the mechanism of the impact of digital inclusive finance on the private enterprises' leverage is elaborated at the theoretical level. Second, the mechanism of the effect of digital inclusive finance in mitigating the enterprises' leverage is empirically tested, which provides effective support for the path of deleveraging of enterprises.

2. Literature Review and Hypothesis Formulation

2.1 Literature review

In exploring the issue of corporate financing constraints, research using the digital inclusive finance model has begun to increase in recent years. Studies have found that SMEs are more willing to accept and use the service models of digital inclusive finance (Muhammad Shahbaz Khan and Sulaman Hafeez Siddiqui 2019); the development of digital inclusive finance has greatly eased the financing constraints of enterprises, in both terms of the breadth of coverage and the depth of usage (Bo Huang 2021).

Other articles have used different modeling approaches to study the heterogeneity of digital inclusive finance in alleviating corporate financing constraints, for example, the heterogeneity test of property rights concluded that its alleviation effect on private enterprises is better than that of state-owned enterprises (Teng Lei 2020), and the stronger mitigating effect on private enterprises in regions with economical drawbacks and those suffering from credit discrimination (Yuan Kun and Zeng De, 2020).

Although there are many factors that affect corporate leverage, there are not many studies on the development of digital inclusive finance and corporate leverage due to the relatively short time of its development. Existing literature suggests that the development of digital inclusive finance can significantly reduce corporate leverage (Ruan Jian et al., 2020), improve the corporate financing environment and reduce the active demand of enterprises to obtain financing through leveraging, thus driving corporate deleveraging (Tang Song et al., 2020), mainly due to optimizing China's financial system, which is dominated by indirect financing, increasing financial accessibility and reducing resource degree of mismatch (Ma Wenting et al., 2021) and other paths that reduce corporate leverage.

A synthesis of the above research findings reveals that most of the existing literature focuses on whether the model of digital inclusive finance can alleviate corporate financing constraints, but few in-depth studies have been conducted on its impact effects. Moreover, the research objects are mostly focused on all listed enterprises or SMEs, there is a lack of research focusing on private enterprises. Therefore, this paper concentrates on the impact effect of this role and explores the impact mechanism of digital inclusive finance on the leverage ratio through alleviating the financing constraints of private enterprises.

2.2 Research hypothesis

On the one hand, digital inclusive finance has lower the threshold for private enterprises to obtain credit funds, shorten the borrowing approval process, and enable private enterprises to efficiently use credit funds from digital inclusive finance to earn more profits, contribute to the improvement of the efficiency of business operation, and increase more net assets, which is reflected in a decrease in corporate leverage (Binbin Zhang et al., 2020). On the other hand, the access of private enterprises to credit funds provided by digital inclusive finance reduces the need for other leveraged financing, thus improving the quality of internal control and risk stability of enterprises (Lin et al., 2021) , which achieves the overall deleveraging effect. Based on this, this paper proposes hypothesisH_1.

H_1: The development of digital inclusive finance will reduce the leverage of enterprises.

Further, an important way for digital finance to reduce the leverage of private enterprises is to alleviate the financing constraints of enterprises. The financing constraint refers to the shortage of endogenous funds while the feasibility of obtaining funds through external financing markets is also constrained. And digital inclusive finance can alleviate the financing constraints received by private enterprises: firstly, its development can broaden financing channels, provide quality services and reduce financing costs through the effects of network and economies of scale; secondly, digital inclusive finance uses information as well as digital technology to reduce financing constraints caused by improper capital allocation within enterprises. Studies have found that digital finance can alleviate corporate financial distress and enhance financial accessibility , and reduce leverage while alleviating

corporate financing constraints, which is a two-fold benefit . Therefore, this paper proposes hypothesis H_2.

H_2: The development of digital inclusive finance will alleviate the financing constraints of private enterprises and thus reduce their leverage ratio.

3. Research Design

3.1 Sample selection and data sources

This paper selects all the listed private companies in Shanghai Stock Exchange and Shenzhen Stock Exchange from 2011 to 2017 as research samples. The sample does not include single data missing, PT, ST and delisted companies; financial enterprises are excluded. A panel data set from 2011 to 2017 was constructed including 1946 enterprises as the research sample. Among them, the leverage ratio data of listed companies and the economic characteristics data of companies are from CSMAR, and the digital financial index comes from the "Peking University Digital Inclusive Finance Index".

3.2 Variable description

The explained variable in this paper is enterprise leverage ratio (Lev), equals to total liability/total asset. The explanatory variable is the Digital Inclusive Financial Development Index. In the empirical part of this paper, the logarithm of the digital financial development index (LnIndex), the logarithm of the breadth of the coverage of digital financial inclusion (LnBreadth) and the logarithm of the depth of the usage (LnDepth) at the municipal level are used as explanatory variables.

The mediating variable is financing constraint(KZ) which was calculated by Kaplan and Zingales (1997). The greater the KZ index, the greater the degree of financing constraints faced by enterprises.

Referring to relevant literature, this paper selected 13 control variables from the company level, industry level, provincial level and other aspects.

Company level: (1) Enterprise age (Age). (2) Enterprise scale (Size), the total assets taken as the natural logarithm. (3) Cash flow (Cash) refers to the natural logarithm of the total cash and cash equivalents held by the enterprise during the current period. (4) Growth (rowth), namely, the growth rate of the total assets at the end of the period. (5) Profitability (Profit), represented by the growth rate of the company's net profit. (6) Ownership concentration (Concen), expressed as the shareholding ratio of the largest shareholder. (7) Whether the two positions are combined (Dual). If the CEO and chairman are combined, the value is 1; otherwise, the value is 0.

Industry level: (8) Return on assets (ROA), that is, the sum of total profit and financial expenses divided by the total assets. (9) Proportion of fixed assets (Fix) refers to the ratio of fixed assets to total assets.

Provincial level: (10) Provincial loan balance (LoanBal), that is, the natural logarithm of the loan balance of each province. (11) Number of lending institutions in the province (Number), that is, the number of financial service institutions in each province, taken as the natural logarithm. (12) Provincial per capital GDP (DP), namely, the natural logarithm of the per capital GDP of each province. (13) Development level of the financial industry of provinces (FinDev), i.e., gross financial product of each province/Gross regional product.

3.3 Model setting

3.3.1 Baseline regression model

This paper firstly verifies whether digital inclusive finance has a significant impact. Based on the Hausman test, a fixed effect model is used to test the impact of digital inclusive finance on private enterprise's leverage level, establishes the following model:

$$Lev_{i,t+1} = a_0 + a_1 Index_{i,t-1} + \sum \varphi CV_{i,t-1} + \sum Year + \sum Industry + \varepsilon \quad (1)$$

3.3.2 Mediating effect model

In order to open the "black box" between digital financial inclusion and corporate leverage ratio and verify financing constraints as mediating channels, this paper further constructs financing constraint models (2) and (3) by referring to the mediation effect test method of Wen Zhonglin et al. (2004):

$$KZ_{i,t} = \beta_0 + \beta_1 \cdot Index_{i,t} + \sum \varphi CV_{i,t-1} + \sum Year + \sum Industry + \gamma \quad (2)$$

$$Lev_{i,t+1} = \alpha + \gamma_1 \cdot Index_{i,t} + \gamma_2 \cdot KZ_{i,t} + \sum \varphi CV_{i,t-1} + \sum Year + \sum Industry + \xi \quad (3)$$

Model (2) is used to verify the impact of digital inclusive finance on financing constraints, with β_1 reflecting the impact of digital inclusive finance on financing constraints. In model (3), both digital financial index and financing constraint variable are taken as explanatory variables, and the significance of coefficient β_1, γ_1 and γ_2 should be examined.

4. Empirical Analysis

4.1 Descriptive statistics

Table 1. Quantitative variable descriptive statistical results

Variables	*Obs*	*mean*	*Std. Dev.*	*Min*	*Max*
Lev	7,301	0.363	0.196	0.00708	0.979
KZ	7,301	0.563	2.483	-11.23	10.92
LnIndex	7,301	5.232	0.509	2.909	5.819
LnBreadth	7,301	5.122	0.565	0.673	5.756
LnDepth	7,301	5.279	0.465	1.911	5.982
Age	7,301	2.645	0.407	0.693	3.714
Size	7,301	21.77	1.047	17.76	27.47
Cash	7,301	19.95	1.139	12.11	25.05
Growth	7,301	0.559	7.262	-0.988	422.6
Profit	7,301	2.112	39.42	-104.8	2,484
Concen	7,301	0.326	0.141	0.00290	0.865
ROA	7,301	0.0524	0.0416	-0.0535	0.590
Fix	7,301	0.189	0.133	8.64e-06	0.788
LoanBal	7,301	13.28	0.632	10.10	14.18
Number	7,301	9.190	0.530	6.920	9.760
GDP	7,301	11.08	0.380	9.706	11.77
FinDev	7,301	0.0758	0.0355	0.0196	0.174
Dual	7,301	0.366	0.482	0	1

The number of effective samples in this experiment is 7301. The mean value of financing constraint (KZ) is 0.563, indicating that there is a certain gap in the degree of financing constraint of different enterprises. The mean value of the total index of digital inclusive finance ($LnIndex$) was 5.232, and the minimum and maximum values were 2.909 and 5.819, respectively. There were also significant differences in the values of coverage breadth ($Breadth$) and usage depth ($Depth$), indicating that the development of digital financial inclusion in China was good on the whole, but the development was not balanced among regions. The other control variables showed little overall fluctuation. The value range of the variables selected in this paper is in the reasonable region, and is basically consistent with the existing literature.

4.2 Regression analysis

4.2.1 The impact of digital inclusive finance on enterprise's leverage level

This paper first uses model (1) to study the relationship between digital financial inclusion and corporate leverage ratio (Lev), and the regression results are shown in Table 2. At the 1% level, the digital financial inclusion index is significantly negatively correlated with the corporate leverage ratio, indicating that increasing the level of digital financial inclusion can significantly reduce corporate leverage level. Therefore, hypothesis H_1 is valid. Digital inclusive financial index of breadth ($LnBreadth$) and depth ($LnDepth$) were used to further analyze the impact of different dimensions. The results show that they are both significantly negatively correlated with Lev at 5% level, indicating that improving the breadth and depth of digital inclusive finance can help enterprises reduce leverage ratio. Therefore, H_1 is established.

Table 2. Digital inclusive finance and enterprise's leverage level

$VARIABLES$	(1) Lev	(1) Lev	(1) Lev
$LnIndex$	-0.048***		
	(-2.679)		
$LnBreadth$		-0.023**	
		(-2.325)	
$LnDepth$			-0.027**
			(-1.973)
Age	0.052***	0.052***	0.052***
	(11.333)	(11.369)	(11.352)
$Size$	0.139***	0.139***	0.139***
	(46.625)	(46.651)	(46.693)
$Cash$	-0.052***	-0.052***	-0.052***
	(-19.533)	(-19.553)	(-19.611)
$Growth$	0.000	0.000	0.000
	(0.222)	(0.247)	(0.215)
$Profit$	0.001***	0.001***	0.001***
	(2.697)	(2.706)	(2.691)
$Concen$	0.056***	0.056***	0.056***
	(4.638)	(4.626)	(4.612)
ROA	-1.182***	-1.182***	-1.180***
	(-26.464)	(-26.464)	(-26.401)
Fix	0.001	0.001	0.000
	(0.042)	(0.045)	(0.021)
$LoanBal$	0.010	0.004	0.001
	(0.578)	(0.253)	(0.039)
$Number$	0.008	0.013	0.017
	(0.492)	(0.771)	(1.049)
GDP	-0.016	-0.013	-0.012
	(-1.054)	(-0.910)	(-0.820)
$FinDev$	-0.001	0.004	0.025
	(-0.007)	(0.030)	(0.194)
$Dual$	-0.005	-0.005	-0.005
	(-1.443)	(-1.439)	(-1.445)
$Constant$	-1.584***	-1.679***	-1.548***
	(-8.218)	(-9.071)	(-8.268)
$Year$ $Industry$		$Controlled$	
Obs	7,281	7,281	7,281
F	88.16	88.12	88.08
R^2	0.527	0.527	0.527
R^2_a	0.521	0.521	0.521

Note: The superscripts *, **, *** indicate the significance level of 10%, 5% and 1% respectively (the same below).

4.2.2 Analysis of mediating effect of the digital inclusive finance on enterprise's leverage level

By analyzing the regression results of model (2), it can be concluded that both $LnIndex$ and $LnDepth$ were negatively correlated with KZ at 1% level and $LnBreadth$ is at 5% level . These indicate that the increase of index and increase in both breadth and depth of the index of digital financial Inclusion can alleviate the financing constraints of enterprises.

By analyzing the regression results of model (3), it can be seen that the influence of KZ on the explained variable Lev has a significant positive correlation. This indicates that easing financing constraints can reduce the leverage ratio of enterprises. The coefficients of index to leverage level after taking consideration of the mediating effect of financing constraints were not significant. Based on the above data analysis results, the following conclusions can be drawn:

The development of digital inclusive finance, as well as the expansion of the breadth of coverage and the development of the depth of usage of digital inclusive finance, can reduce the level of corporate leverage by easing the financing constraint, and the financing constraint acts as a full intermediary. Therefore, H_2 is established.

Table 3. Analysis of the mediating effect of financial constraints

$VARIABLES$	(2) KZ	(3) Lev	(2) KZ	(3) Lev	(2) KZ	(3) Lev
$LnIndex$	-0.559***	-0.022				
	(-2.753)	(-1.450)				
$LnBreadth$			-0.234**	-0.012		
			(-2.099)	(-1.438)		
$LnDepth$					-0.457***	-0.006
					(-2.882)	(-0.542)
KZ		0.046***		0.046***		0.046***
		(52.183)		(52.205)		(52.202)
Age	0.514***	0.028***	0.516***	0.028***	0.514***	0.028***
	(9.866)	(7.186)	(9.902)	(7.204)	(9.880)	(7.200)
$Size$	1.787***	0.057***	1.789***	0.057***	1.790***	0.057***
	(52.582)	(19.022)	(52.609)	(19.025)	(52.667)	(19.032)
$Cash$	-1.786***	0.030***	-1.787***	0.030***	-1.788***	0.030***
	(-58.639)	(10.819)	(-58.660)	(10.820)	(-58.743)	(10.799)
$Growth$	-0.119***	0.006***	-0.118***	0.006***	-0.119***	0.006***
	(-5.422)	(3.590)	(-5.393)	(3.603)	(-5.453)	(3.602)
$Profit$	0.003	0.001***	0.003	0.001***	0.002	0.001***
	(0.546)	(2.831)	(0.553)	(2.837)	(0.540)	(2.827)
$Concen$	-0.119	0.062***	-0.121	0.062***	-0.122	0.062***
	(-0.854)	(5.971)	(-0.869)	(5.967)	(-0.877)	(5.955)
ROA	-22.719***	-0.141***	-22.718***	-0.141***	-22.684***	-0.140***
	(-44.460)	(-3.286)	(-44.447)	(-3.285)	(-44.395)	(-3.250)
Fix	-1.223***	0.057***	-1.223***	0.057***	-1.225***	0.056***
	(-6.772)	(4.204)	(-6.772)	(4.209)	(-6.786)	(4.189)
$LoanBal$	-0.398**	0.028**	-0.484***	0.026*	-0.446**	0.021
	(-2.111)	(1.978)	(-2.650)	(1.928)	(-2.478)	(1.571)
$Number$	0.341*	-0.007	0.412**	-0.006	0.399**	-0.001
	(1.781)	(-0.518)	(2.193)	(-0.445)	(2.169)	(-0.104)
GDP	0.230	-0.026**	0.262	-0.025**	0.257	-0.024*
	(1.347)	(-2.066)	(1.545)	(-2.020)	(1.521)	(-1.900)
$FinDev$	2.963**	-0.137	3.081**	-0.137	3.155**	-0.120
	(2.014)	(-1.248)	(2.092)	(-1.252)	(2.157)	(-1.100)
$Dual$	-0.013	-0.004	-0.013	-0.004	-0.013	-0.004
	(-0.332)	(-1.490)	(-0.329)	(-1.487)	(-0.333)	(-1.492)
$Constant$	0.761	-1.619***	-0.457	-1.658***	-0.453	-1.528***
	(0.345)	(-9.862)	(-0.216)	(-10.519)	(-0.212)	(-9.578)
$Year$	$Controlled$		$Controlled$		$Controlled$	
$Industry$						
Obs	7,281	7,281	7,281	7,281	7,281	7,281
F	115.83	149.82	115.75	149.82	115.85	149.76
R^2	0.595	0.657	0.594	0.657	0.595	0.657
R^2_a	0.589	0.653	0.589	0.653	0.589	0.652

4.2.3 Heterogeneity Analysis

(1) Heterogeneity analysis based on enterprise sizes

There are different financing and information constraints faced by enterprises of different sizes. This paper further explores the differences in the impact of digital inclusion finance on enterprises of different sizes by classifying them into different groups according to asset sizes. The regression results are shown in Table 4. The impact of digital inclusive finance on the leverage ratio is significant at the 1% level for large-scale enterprises, while that of small firms is not significant, indicating that the impact on leverage of large scale private enterprises is greater. The possible reason for this is that large enterprises have easier access to external financing, resulting in higher levels of leverage, and thus digital inclusive finance has a more pronounced effect on reducing leverage for large enterprises . It can be seen from Column (3) that financing constraints show a full mediating effect.

Table 4. Heterogeneity analysis based on enterprise sizes

	Large-scale			Small and medium-sized		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
	Lev	*KZ*	*Lev*	*Lev*	*KZ*	*Lev*
KZ			0.046***			0.045***
			(34.523)			(37.298)
LnIndex	-0.071**	-0.907***	-0.029	-0.024	-0.403	-0.006
	(-2.402)	(-2.746)	(-1.141)	(-1.048)	(-1.535)	(-0.302)
CVs		*Controlled*			*Controlled*	
Year		*Controlled*			*Controlled*	
Industry						
Obs	*3,322*	*3,322*	*3,322*	*3,959*	*3,959*	*3,959*
F	*45.52*	*64.62*	*75.26*	*19.77*	*66.97*	*42.38*
R^2	*0.548*	*0.632*	*0.669*	*0.308*	*0.601*	*0.491*
R^2_a	*0.536*	*0.622*	*0.661*	*0.292*	*0.592*	*0.479*

(2) Heterogeneity analysis based on the term of leverage

An enterprise's long-term leverage ratio is long-term liabilities/total assets and its short-term leverage ratio is short-term liabilities/total assets. As can be seen from the table, the impact of digital inclusive finance on reducing the level of short-term leverage of enterprises is significant at the 1% level with an coefficient of -0.049, while the impact on the level of long-term leverage is not significant. This suggests that digital inclusion can reduce the level of short-term leverage by alleviating financing constraints and that plays a fully mediating role. This may be because digital inclusive finance enables private companies to access more capital from financial markets, especially short-term borrowing.

Table 5. Heterogeneity analysis based on term of leverage

	Short-term leverage			Long-term leverage		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
	SLev	*KZ*	*SLev*	*LLev*	*KZ*	*LLev*
KZ			0.022***			0.005***
			(19.654)			(6.030)
LnIndex	-0.049***	-0.932***	-0.028	-0.010	-0.416	-0.008
	(-2.699)	(-3.370)	(-1.642)	(-0.966)	(-1.627)	(-0.791)
CVs		*Controlled*			*Controlled*	
Year		*Controlled*			*Controlled*	
Industry						
Obs	3,001	3,001	3,001	3,041	3,041	3,041
F	13.50	49.51	19.60	15.24	46.26	15.67
R^2	0.282	0.591	0.366	0.307	0.574	0.316
R^2_a	0.262	0.579	0.348	0.287	0.562	0.296

(3) Heterogeneity analysis based on regions

China is a vast country with large differences in economic development between the eastern, middle and western regions. Economically developed regions have access to more financial services, better systems and relatively transparent information disclosure, so enterprises in those regions are more likely to receive financial support and suffer from less financing constraints. The results in Table 6 show that the impact on the leverage ratio of enterprises in the middle and western regions is relatively more significant, probably because the conventional financial system in the central and western regions is not well established , thus digital inclusive finance exerts a stronger effect in alleviating the financing constraints, reducing the leverage ratio of enterprises to a larger extent .

Table 6. Heterogeneity analysis based on regions

	Eastern regions			Middle and Western Regions		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
	Lev	*KZ*	*Lev*	*Lev*	*KZ*	*Lev*
KZ			0.049***			0.045***
			(20.247)			(44.286)
LnIndex	-0.116*	-3.185***	0.039	0.021	-0.857***	0.060***
	(-1.664)	(-4.408)	(0.634)	(0.793)	(-2.807)	(2.598)
CVs		*Controlled*			*Controlled*	
Year		*Controlled*			*Controlled*	
Industry						
Obs	1,289	1,289	1,289	5,592	5,592	5,592
F	23.22	43.27	35.97	71.53	92.85	117.51
R^2	0.567	0.714	0.677	0.539	0.603	0.660
R^2_a	0.593	0.731	0.696	0.532	0.597	0.655

5. Robustness tests

5.1 Impact of lagging phase 1 of digital inclusion finance on corporate leverage

Table 7. Robustness tests of explanatory variables with one lagged period

VARIABLES	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
	Lev	*KZ*	*Lev*	*Lev*	*KZ*	*Lev*	*Lev*	*KZ*	*Lev*
LnIndex	-0.045***	-0.630***	-0.016						
	(-2.725)	(-3.399)	(-1.114)						
LnBreadth				-0.018**	-0.291***	-0.005			
				(-2.033)	(-2.885)	(-0.617)			
LnDepth							-0.032**	-0.392***	-0.014
							(-2.497)	(-2.719)	(-1.263)
KZ			0.047***			0.047***			0.047***
			(48.656)			(48.691)			(48.678)
CVs		*Controlled*			*Controlled*			*Controlled*	
Year		*Controlled*			*Controlled*			*Controlled*	
Industry									
Obs	6,417	6,417	6,417	6,417	6,417	6,417	6,417	6,417	6,417
F	77.10	103.97	131.92	77.10	103.97	131.92	77.07	103.86	131.93
R^2	0.512	0.586	0.645	0.511	0.585	0.645	0.512	0.585	0.645
R^2_a	0.505	0.580	0.640	0.505	0.580	0.640	0.505	0.580	0.640

The paper uses the one-period lagged values of the Digital Inclusive Financial Index to measure the level of digital inclusion, replacing it with the meaning of the one-period lagged impact of digital

inclusion on corporate leverage, mitigating to some extent the problem of reverse causality. Table 7 lags the total digital inclusion index and the two secondary indicators by one period and runs the regressions. The coefficient of digital financial inclusion was significantly positive at the 5% level, again supporting the robustness of the baseline regression.

5.2 Exclusion of municipalities

The sample data of four municipalities (Beijing, Shanghai, Tianjin and Chongqing) were removed from the paper, and the panel was reconstructed and regressed again. The regression results in Table 8 show that, although there are slight differences in the magnitude of the coefficients, there is basically no difference in direction and significance, meaning that the attenuating effect of digital inclusive finance on corporate leverage remains robust after excluding the sample .

Table 8. Robustness tests of elimination of the impact of municipalities

VARIABLES	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
	Lev	*KZ*	*Lev*	*Lev*	*KZ*	*Lev*	*Lev*	*KZ*	*Lev*
LnIndex	-0.042**	-0.726***	-0.008						
	(-2.197)	(-3.333)	(-0.491)						
LnBreadth				-0.017*	-0.271**	-0.005			
				(-1.653)	(-2.288)	(-0.509)			
LnDepth							-0.036**	-0.588***	-0.008
							(-2.398)	(-3.482)	(-0.635)
KZ			0.047***			0.045***			0.047***
			(49.169)			(44.286)			(49.158)
CVs		*Controlled*			*Controlled*			*Controlled*	
Year		*Controlled*			*Controlled*			*Controlled*	
Industry									
Obs	6,138	6,138	6,138	6,138	6,138	6,138	6,138	6,138	6,138
F	72.98	99.99	128.15	72.98	99.99	128.15	72.98	99.99	128.15
R^2	0.515	0.593	0.653	0.5150	0.5926	0.6535	0.5150	0.5926	0.6535
R^2_a	0.5079	0.5867	0.6484	0.5079	0.5867	0.6484	0.5079	0.5867	0.6484

6. Conclusions

This paper empirically tested the mechanism of the impact of digital inclusive finance on the private enterprises' leverage using industry and annual fixed-effects model and mediating effect model based on private enterprises listed on the Shanghai Stock Exchange and Shenzhen Stock Exchanges in China and the Digital Inclusive Finance Index from Peking University from 2011-2017. The findings are as follows. (1) Digital inclusive finance can significantly reduce the leverage of private enterprises, and this is mainly achieved by alleviating the financing constraints of private enterprises. The results still hold by excluding municipality data and lagged explanatory variables for robustness testing. (2) The impact of digital inclusive finance in reducing the leverage of private enterprises is more significant in large-scale enterprises, probably due to large-scale enterprises themselves have higher leverage ratios and greater leverage elasticity. (3) The effect of digital inclusive finance in reducing short-term leverage is more significant than that of reducing long-term leverage. (4) It has a more obvious effect on the middle and western regions where financial resources and institutional environment are relatively poor.

The results of this paper have certain policy implications. First, as digital inclusive finance has the dual role of alleviating enterprises' financing constraints and deleveraging, more funds should be invested in digital technology to promote the development of digital inclusive finance. Second, digital inclusive finance should be fully utilized to promote financial supply-side reform and enhance the

ability of financial services to serve private enterprises and enterprises in central and western regions . Third, traditional financial institutions should accelerate the combination with digital technology to fully expand the coverage of digital inclusive finance, so as to provide an effective solution to the difficulties in financing for enterprises.

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