

Digital Finance, Corporate Finance, And the Shadow Banking of Non-Financial Corporations

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Keywords: Digital finance; Financing constraints; non-financial firms; Shadow banking

Abstract: With the continuous progress and development of digital finance in China, many non-financial enterprises have gradually entered the scope of shadow banking activities. This paper uses panel data empirical analysis of A-share non-financial listed companies from 2011 to 2019 to find that the increase in the level of digital finance development will expand the scale of shadow banking of enterprises, and this effect is more significant in regions with high marketization; facing different ownership enterprises, the degree of impact of digital finance development on shadow banking of state-owned enterprises is more significant than that of non-state-owned enterprises. The mechanism test finds that an increase in the level of digital finance will relax the degree of financing constraints and make it easier for firms to obtain financing; this in turn has an impact on corporate shadow banking. This paper opens the study of digital finance as an explanatory variable and has important implications for financial markets to better serve the real economy.

1. Introduction

In recent years, with the integration of the Internet and other digital technologies with traditional financial services, China's financial digitization has deepened. In September 2016, China formulated the G20 Advanced Principles for Digital Inclusive Finance with participating countries in the G20 Leaders' Summit in Hangzhou, committing to the use of digital information technology to enhance financial services. The forward development of digital finance has provided new solutions to alleviate the problems of difficult and expensive financing for SMEs. However, digital finance may also bring some negative impacts. As an emerging financial model, it has alleviated some of the problems of information asymmetry, but the inherent attributes of the financial industry still exist, and in the absence of regulation, the dilemma of the prevalence of the Ponzi scam may arise (Zheng Liansheng, 2014).

There is also an important question as to whether digital finance will lead to a further "de-realization" of non-financial real enterprises and the emergence of shadow banking. Although shadow banking is not new in China, it has entered a phase of rapid growth since 2008. With the continuous development of the financial market, more and more non-financial enterprises are now using multiple channels of funding for substantive lending activities, becoming a new kind of shadow credit market participant (Han Xun et al. 2017; Liu Jun et al. 2014). On the one hand, the shadow banking of non-financial enterprises has opened the service boundaries of traditional finance and eased the pressure of financing difficulties for SMEs; on the other hand, such activities lack behavioral norms and are prone to evade effective regulation. Therefore, it is of great theoretical and practical significance to explore the influencing factors of shadow banking by non-financial enterprises, improve the problem at its source, and promote the orderly development of the economic environment.

The innovations of this paper are: first, this paper examines the factors influencing the scale of shadow banking of non-financial enterprises from the perspective of digital finance. Second, this paper further investigates the mechanism of the effect of digital finance on the shadow banking of non-financial firms, analyzes how digital finance affects firms' financing and thus leads to their shadow banking, and analyzes the heterogeneous effects of digital finance on the shadow banking of non-financial firms in terms of region and firm ownership, deepening and extending the empirical findings;

Third, this paper discusses the possible negative effects of digital finance, which has certain practical implications.

The remainder of the paper is structured as follows: Part II provides a review and overview of existing research, Part III presents the research data and research design, Part IV presents the benchmark regressions, heterogeneity analysis and robustness tests, Part V provides further discussion and analysis of the mechanism, and Part VI presents the conclusion and related policy recommendations.

2. Literature review and theoretical analysis

With the real economy in the doldrums and the economy moving away from the real to the virtual, many non-financial firms take advantage of their financing advantages, such as overcapitalization and diversified financing channels, to lend funds to other demanders and profit from them. Shadow banking is also known as the "parallel banking system", which includes non-bank financial institutions such as insurance companies, etc. McCulley (2007) suggests that shadow banking can refer to those forms of finance that have the function of a bank but are not organized as a bank and are not regulated by the government. FSB (2011) defines it as a system of credit intermediation outside the banking regulatory system that may cause problems such as systemic risk. While the shadow banking of these non-bank financial institutions has emerged, scholars have also focused on the shadow banking of non-financial corporations that are outside the bank regulatory system as an important component of Chinese-style shadow banking activities. Li and Han Xun (2019) point out that non-financial firms in China mainly engage in shadow banking by acting as "substantive credit intermediaries" and indirectly participating in the "shadow credit market".

What, then, is the cause of shadow banking by NFCs? Much research has been conducted on the causes of shadow banking by non-financial corporations. Research suggests that, overall, the inherent profit-seeking nature of firms and the macro-financial system have combined to drive the trend towards shadow banking by non-financial firms. From the perspective of the enterprises themselves, the financial sector has a higher rate of return on investment than the real sector, and non-financial enterprises have the urge to enter the financial sector, but objective factors such as financial license management and monopoly operations have led to high barriers to entry into the financial sector. As a result, non-financial firms turn to the shadow banking system to earn high returns (Han Xun et al., 2017). Liu Jun et al. (2014) find that the two main reasons for firms to engage in shadow banking are imbalance in financing layout and currency over-issuance, and the profit-seeking nature of capital leads firms to invest large amounts of capital into the shadow banking system. Wang Yongqin et al. (2015) argue that the uneven supply and demand of funds in the financial market can also lead to shadow banking by non-financial firms.

Currently, the existing literature mainly answers the reasons for the participation of non-financial firms in the shadow banking market from the perspective of the macro-financial system and other perspectives. In recent years, digital finance has changed the original financial system to some extent and has had an important impact on all aspects of the economy and society. Studies by many scholars have shown that digital finance can improve the problem of poverty and wealth in rural areas and promote economic development. Based on factor analysis, Yin Zhichao and Zhang Donghao (2018) concluded that financial inclusion has a significant negative impact on rural household poverty vulnerability. From the perspective of rural credit, Qiuzi Fu and Yiping Huang (2018) found that digital finance not only reduces rural productive formal credit demand at the same time increases rural consumer formal credit demand.

In addition to improving rural poverty, digital financial development has a significant impact in terms of innovation and entrepreneurship. Xie Jiali et al. (2018) and Wan Jia Yu et al. (2020) concluded that digital finance development not only has a significant effect on entrepreneurship at the macro level; but also has a positive effect on the breadth of coverage, depth of use and the extent of digital support services. Tang et al. (2020) concluded that digital finance development has a "structural" effect on technological innovation, helping to increase technological innovation output. Another small group of scholars considered the impact of digital financial development on traditional financial institutions

such as banks. Qiu Han et al. (2018) finds that fintech changes banks' liabilities, which in turn leads to higher risk-taking preferences in the asset direction and lower borrowing rates and net interest margins.

Current research on the impact of digital finance generally suggests that the impact of digital finance on the economy is skewed towards the positive, but the possible risks of digital finance are less explored. Indeed, digital finance may also lead to a range of problems. The study of the impact of digital finance on corporate shadow banking is of great academic importance.

3. Data, empirical design, and description of variables

3.1 Data

First, the financial data of listed companies are obtained from the Guotaian CSMAR database of listed companies in China, which is used to construct indicators of the degree of shadow banking and corporate financing constraints; and to construct a series of control variables based on the financial information of listed companies. Secondly, the Digital Inclusive Finance Index was constructed by the Digital Finance Research Centre of Peking University, which is used to measure the extent of digital finance development.

The research object of this paper is A-share listed companies in Shanghai and Shenzhen, and, referring to the practices in the general literature, firstly, the financial listed companies are excluded from the sample, then the ST category companies with abnormal profitability and financial status are excluded, and the companies with serious missing financial data are also excluded, and all continuous variables are subjected to 1% and 99% tail shrinkage to eliminate the influence of extreme values on the data, finally this paper obtains panel data of A-share non-financial listed companies from 2011 to 2019, with a total of 33,683 sets of observations.

3.2 Empirical design

The baseline regression equation of this paper is

$$SB_{it} = \beta_0 + \beta_1 DF_{dt} + \theta X + u_i + \varepsilon_{it}$$

The regression equation for testing the effect of heterogeneity in the degree of regional marketization in this paper is

$$SB_{it} = \beta_0 + \beta_1 DF_{dt} * M_{dt} + \theta X + \varepsilon_{idt}$$

The regression equation to test the effect of heterogeneity between SOEs and non-SOEs in this paper is

$$SB_{it} = \beta_0 + \beta_1 DF_{dt} + \beta_2 DF_{dt} * SOE_i + \theta X + \varepsilon_{idt}$$

The regression equation in this paper in testing the financing constraint mechanism is

$$FC_{it} = \beta_0 + \beta_1 DF_{dt} + \theta X + \varepsilon_{idt}$$

3.3 Description of variables

1) Shadow banking: SB_{it} represents the size of shadow banking of firm i in year t , calculated as the sum of entrusted loans, entrusted finance, and other receivables of the firm in that year. When testing for industry heterogeneity, SB_{ijt} represents the shadow banking of firm i in industry j in year t . When testing for regional heterogeneity, SB_{idt} represents the shadow banking of firm i in region d in year t . Both are calculated as above.

2) Digital Financial Inclusion: DF_{dt} represents the degree of digital financial development in region d where the firm is in year t . This paper adopts the provincial-level China Digital Financial Inclusion Development Index, which is compiled by the Digital Finance Research Centre of Peking University (Guo Feng et al., 2020), to measure the development of digital finance in each region of China. The index uses big data on transaction accounts from Ant Financial Services, which is quite representative and realistic; and is also widely used by existing studies on digital finance and financial inclusion. The database constructs the digital financial inclusion system from three dimensions:

breadth of coverage, depth of use and digital support services of digital financial services, specifically consisting of 10 secondary dimensions and 26 specific indicators.

3) Financial Constraint: FC_{it} represents the degree of financial constraint faced by company i in year t . This paper is based on the multi-dimensional information score, the specific calculation method refers to Jain (2001), Yang Jiayu (2012), from the endogenous funding constraints, commercial credit funding constraints, exogenous funding constraints, foreign capital participation, investment opportunities and profitability five dimensions, the specific selection of enterprise nine financial indicators, including the enterprise cash stock ratio, commercial credit funding constraints, foreign investment opportunities and profitability. These include the firm's cash stock ratio, commercial credit ratio, firm size, net tangible assets ratio, liquidity ratio, liquidity ratio, the share of foreign investment, return on assets, and net sales margin. This indicator is assigned according to the position of the company in the industry for that year. For example, the ROA of all companies in the same industry in the same year is ranked from smallest to largest and assigned a score of 1, 2, 3, 4 and 5 in the range of 0-20%, 20%-40%, 40%-60%, 60%-80% and 80%-100% respectively. The company's scores on all nine indicators for the year were calculated and summed to give the company's degree of financing constraint for that year. To test for industry heterogeneity, FC_{ijt} represents the degree of financing constraint of the company i in industry j in year t . To test for regional heterogeneity, FC_{idt} represents the degree of financing constraint of the company i in region d in year t . The calculation method is the same as above.

4) Control variables: Concerning existing studies, this paper selects some financial indicators of enterprises that may affect their shadow banking behavior, which are used as control variables in this paper. Firstly, enterprise size, the logarithm of total assets is selected as a measure of enterprise size; secondly, monetary capital, the proportion of monetary capital in total assets is selected as a measure of enterprise size; thirdly, enterprise age, the time of the establishment of each listed company is collected and the current year minus the time of establishment is used as a measure of enterprise age; fourthly, profitability, the weighted assets of the enterprise is used as a measure of enterprise profitability. Fourth, profitability, this paper uses the weighted return on assets as a measure of the profitability of the enterprise.

4. Baseline Regression, Heterogeneity Analysis and Robustness Test

4.1 Baseline regression results

The article uses a panel fixed effects model to empirically test the impact of digital finance on corporate shadow banking. The results of the benchmark regressions are shown in Table 1. Column (1) of Table 1 controls for year fixed effects, and the regression results show that the coefficient of digital financial development (df) is 0.00253 and is significantly positive at the 1% statistical level, indicating that digital financial development exacerbates the degree of shadow banking of non-financial firms. Column (2) controls for industry fixed effects in column (1), and the core indicator digital financial development (df) is significantly positive at the 5% statistical level, indicating that digital finance and shadow banking tend to move positively, regardless of industry. Adding control variables to the former, the regression results, as shown in column (3), are still significantly positive at the 5% statistical level, indicating that with further control variables, the degree of corporate shadow banking weakens somewhat with the development of digital finance.

Specifically, digital finance makes it easier for firms to obtain finance from the financial markets, mainly by lowering the barriers. Some businesses have been unable to access credit facilities in part because traditional bank financing requires comprehensive corporate data, as well as a certain level of collateral to secure the business. As the digitization of our economy continues, it has not only facilitated more financial institutions to provide financing to businesses through digital technology means, but has also increased the number of relevant channels and, ultimately, digital finance has made corporate financing less constrained. However, due to the downturn in the real economy and the low returns on real investment, this reduced financing constraint may in turn lead to greater involvement of enterprises in the process of shadow banking and the use of excess funds for substantive credit

operations, resulting in the "shadow banking" of manufacturing enterprises.

Table 1 Baseline regression results

	(1)	(2)	(3)
	lnsb	lnsb	lnsb
df	0.00253***	0.00237**	0.00215**
	(2.65)	(2.45)	(2.41)
cv1			2.18e-11***
			(20.89)
cv2			-0.941***
			(-6.87)
cv3			0.00238
			(0.51)
cv4			0.00637***
			(4.22)
Year fixed effect	Control	Control	Control
Industry fixed effect		Control	Control
_cons	18.48***	18.86***	18.61***
	(83.35)	(69.57)	(68.85)
<i>N</i>	7730	7730	7724

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.2 Heterogeneity analysis: degree of regional marketisation

The degree of marketisation of a region represents the degree of financial development. An increase in marketisation can reduce information asymmetry between enterprises and financial institutions, lowering their own financing constraints and thus promoting shadow banking. China's regional financial development and the degree of marketisation are uneven due to the obvious differences in resources between regions and the focus of national support policies (Wang Xiaolu et al., 2016). This paper refers to the latest index of differences in marketisation between regions in China constructed by Wang Xiaolu et al. (2019) as a measure of the degree of regional marketisation. In the empirical results below, the variable is denoted as a market.

Table 2 Digital finance and shadow banking of non-financial firms: regional heterogeneity

	(1)	(2)	(3)
	lnsb	lnsb	lnsb
df*market	0.000423***	0.000317***	-0.0000122
	(15.35)	(11.66)	(-0.12)
cv1		2.52e-11***	7.37e-12**
		(21.37)	(2.08)
cv2		-1.251***	-1.813***
		(-7.65)	(-8.04)
cv3		0.0185***	0.228***
		(3.57)	(6.02)
cv4		0.00714***	0.00631**
		(3.50)	(2.48)
Year fixed effect			Control
Individual fixed effect			Control
_cons	19.34***	19.21***	16.71***
	(285.40)	(178.13)	(36.15)
<i>N</i>	5479	5476	5476

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

To further test the impact of digital finance development on the heterogeneity of regional

marketization degree of corporate shadow banking, a cross-sectional term between digital finance and regional marketization degree is constructed and added to the regression in this paper, and the regression results are shown in Table 2. Column (1) of the table does not control for variables and is positively significant at the 1% statistical level. Column (2), on the other hand, controls for control variables such as firm size, and the regression coefficient on the cross-multiplier term is positive at the same level; column (3) controls for a year and industry fixed effects.

A positive coefficient before the cross term implies that the higher the degree of regional marketisation, the greater the impact of digital finance development on the process of corporate shadow banking. The reason for this is that the development of regions with high marketisation can lead to higher indicators such as return on assets for firms compared to regions that are lagging in marketisation, resulting in a higher index of financing constraint scores, i.e., lower financing constraints, which induces firms to shadow bank to a greater extent.

4.3 Heterogeneity analysis: enterprises with different ownership

To further explore the analysis of enterprise heterogeneity in the development of digital finance on the shadow banking of enterprises, based on the regression of the total sample, the article classifies enterprises with different ownership into state-owned enterprises and non-state-owned enterprises according to the nature of enterprise ownership, specifically, this article collects the actual controllers and the nature of enterprises as of December 30, 2020. If the nature of the enterprise is "local state-owned enterprise", "central state-owned enterprise", "state-owned enterprise", "collective enterprise", or the beneficial owner of the enterprise is "Central State-owned Assets Supervision and Administration Commission", "Local State-owned Assets Supervision and Administration Commission", "State-owned Assets Supervision and Administration Commission", or "Collective-owned", then the enterprise's beneficial owner is If the enterprise is "collectively owned", then this paper identifies the enterprise as a state-owned enterprise, while other types of enterprises are classified as non-state-owned enterprises. In the empirical results below, this variable is noted as SOE.

Table 3 Digital finance and shadow banking of non-financial firms: firm heterogeneity

	(1)	(2)	(3)
	lnsb	lnsb	lnsb
df	0.00251***	0.00234**	0.00213**
	(2.65)	(2.43)	(2.39)
df*soe	0.00130***	0.000910***	0.000256
	(6.28)	(4.18)	(1.23)
cv1			2.15e-11***
			(20.32)
cv2			-0.947***
			(-6.91)
cv3			0.00140
			(0.30)
cv4			0.00650***
			(4.30)
Year fixed effect	Control	Control	Control
Industry fixed effect		Control	Control
cons	18.49***	18.78***	18.60***
	(83.47)	(69.17)	(68.80)
N	7730	7730	7724

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In this paper, the ownership dummy variable is crossed into the regression with the digital finance index. The results are shown in Table 3. Columns (1)-(3) in Table 3 are treated in the same manner as the benchmark regression. The results show that the digital finance (df) coefficients are all positively significant at the corresponding statistical levels, consistent with the results of the benchmark

regression. Also, the regression coefficients of the cross-product term are positive at the 1% statistical level, regardless of whether year and industry fixed effects are performed. The reason for this is that the credit market has more stringent financing requirements and restrictions for non-state enterprises compared to state-owned enterprises. Yu Kun et al. (2014) find that the government generally has a policy bias towards SOEs and is more inclined to give them more credit support. The fact that SOEs themselves do not have difficulty in obtaining financing from state-owned banks, coupled with policy support, further leads to the extent to which the development of digital finance affects the shadow banking of SOEs to a more significant degree than that of non-SOEs.

4.4 Robustness tests

As this paper uses a sample of listed companies, the time of listing varies from company to company and not all companies were listed and present in the sample in 2006 at the beginning of the sample, hence the unbalanced panel data used in this paper in the main regression. In this part of the robustness test, only listed companies that were present in the sample from 2011 to 2019 are retained in this paper to construct a balanced panel data set as a robustness test. The regression results show that the coefficients of digital finance (df) are all significantly positive at the 1% statistical level, at 0.00340, 0.00320 and 0.00255 respectively, which remain consistent with the conclusions drawn from the benchmark regression equation, indicating that the empirical results are strongly robust to the idea that digital finance development helps promote shadow banking by firms.

Table 4 Robustness test regression results

	(1)	(2)	(3)
	lnsb	lnsb	lnsb
df	0.00340***	0.00320***	0.00255***
	(3.20)	(2.97)	(2.58)
cv1			2.13e-11***
			(19.68)
cv2			-1.004***
			(-6.67)
cv3			0.00215
			(0.40)
cv4			0.00681***
			(4.24)
Year fixed effect	Control	Control	Control
Individual fixed effect		Control	Control
cons	18.46***	18.85***	18.61***
	(81.34)	(66.58)	(65.72)
<i>N</i>	6967	6967	6961

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5. Further Discussion: Analysis of Mechanisms

5.1 Mechanism analysis: financing constraints

To further test the mechanism of the effect of digital finance on corporate shadow banking, this paper first replaces the explanatory variable with financing constraint (fc) to test the mediating mechanism. Column (1) of the table performs fixed effects on the year, column (2) controls for industry fixed effects on top of the previous ones at the same time, and column (3) analyses the data with the inclusion of control variables. The regression results show that the coefficient of digital finance (df) is positively significant at the 1% statistical level, indicating that digital finance has a significant contribution to financing constraints, i.e., the development of digital finance will relax the degree of financing constraints, making it easier for firms to obtain financing. The specific reason is that the

development of digital finance can solve the credit problems of both the supply and demand sides of funds through low cost, while digital finance changes the credit conditions of traditional financial institutions, uses the advantages of digital technology of low cost and convenience and efficiency to reconstruct the credit assessment mechanism of enterprises, and conducts an all-round and multi-dimensional examination of the business condition and risk level of enterprises (Qi Liang et al., 2020), improves the efficiency of financing and reduce corporate financing costs, thereby alleviating corporate financing constraints, which in turn leads to corporate shadow banking.

Table 5 Analysis of mechanisms: financing constraints

	(1)	(2)	(3)
	fc	fc	fc
df	0.00182***	0.00191***	0.00109***
	(9.07)	(9.38)	(7.63)
cv1			1.45e-13
			(0.98)
cv2			1.668***
			(116.68)
cv3			-0.00412**
			(-5.27)
cv4			0.0128***
			(110.12)
Year fixed effect	Control	Control	Control
Industry fixed effect		Control	Control
cons	2.902***	2.875***	2.480***
	(198.42)	(71.36)	(81.93)
<i>N</i>	33683	33683	33268

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6. Conclusions and policy implications

In recent years, digital finance, as an effective complement to traditional finance, has had an impact on the shadow banking of non-financial firms through its effect on corporate financing constraints and, in turn, on the shadow banking of non-financial firms. This paper empirically examines the impact of digital finance on the shadow banking of non-financial firms using data from listed companies from 2011 to 2019, and examines the heterogeneity and mechanisms. In general, the degree of digital finance development in a country can have a positive effect on corporate shadow banking, i.e., drive the shadow banking process. At the same time, the more market-oriented the region, the more digital finance can facilitate the development of shadow banking by enterprises; in the face of different ownership, digital finance has a significant effect on the shadow banking of more state-owned enterprises. Further research finds that digital finance deepens the shadow banking of enterprises by alleviating their financing constraints.

Based on the findings of this paper, the following policy recommendations are proposed: First, the state should strengthen the regulation of digital finance and focus on the development of the real economy based on encouraging the innovation and development of digital finance. Second, an identification mechanism for enterprises involved in shadow banking activities should be established. Develop a shadow banking information disclosure system, and include macro and micro indicators in the identification scope for reasonable planning, and establish and improve the corresponding information collection platform. Third, focus on the regional balance of the promotion effect of digital finance on shadow banking, and further eliminate the impact of the "digital divide" on shadow banking. Promote digital technology empowerment to ease financing constraints and thus promote shadow banking.

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