

Can Digital Finance Promote Corporate Investment?

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Abstract

As a cutting-edge financial business model under the deep integration of technology and finance, digital finance may have an underlying impact on the development of the real economy. Using Chinese manufacturing private listed firms from 2011-2018 as a sample, this paper empirically examines the impact of digital finance on the investment expenditure of private firms. The study reveals that digital finance can significantly promote the increase in investment expenditure level of private firms. Further research shows that the promotion effect of digital finance on private firms' investment is more significant in a high proportion of intangible assets and in areas with weak traditional financial development levels. In general, the development of digital finance helps to alleviate the problem of resource mismatch in Chinese traditional finance, promotes the improvement of firms' investment level, and plays a positive role in stabilizing fixed asset investment.

Keywords-digital finance; corporate investment; intangible asset collateral

1. INTRODUCTION

Since the reform and opening-up policy in 1978, the Chinese manufacturing industry has developed continuously and rapidly, and has made remarkable achievements on both the total scale and the technical level. However, since the global financial crisis in 2008, the investment level of China's manufacturing industry has been declining. According to the data from the National Bureau of Statistics, the growth rate of fixed investment in the secondary industry decreased from 26.14% in 2007 to 3.26% in 2017. The decline in the investment growth rate of private firms is even more worrying.

Previous literatures have found that financial development can alleviate the financial constraints, and increase firms' R&D and fixed asset investment, which promote economic growth [1,2]. After long-term development, China has formed a financial system dominated by the banking sector and supplemented by the capital market. Although the bank-led financial system can provide necessary capital support in the rapid development stage of China's economy, it also seriously limits the option of financial products of entity firms and residents, resulting in unreasonable distortion of financial factor prices for a long time, making it difficult to give full play to the core role of the market in the allocation of financial resources [3,4]. With the rapid development of

emerging information technologies such as big data, artificial intelligence, and cloud computing, the integration of finance and technology has reached an unprecedented level [5,6]. Taking China as the representative, digital finance has developed rapidly, which has a strong impact on economic and social operations.

Digital finance generally refers to traditional financial institutions and internet companies using digital technology to realize financing, payment, investment and other new financial business models, which is basically similar to the essential meaning of financial technology. Digital finance has become a research hotspot in the field of financial economics [7]. Then, can the development of digital finance reduce the mismatch of traditional financial resources and promote the investment of manufacturing companies? Using Chinese manufacturing private listed firms from 2011-2018 and the digital inclusive finance index compiled by the digital finance research center of Peking University, this paper discusses the impact of the development of digital finance on firm investment.

The possible marginal contributions of this paper are as follows: first, this paper enriches and expands the research on financial development and corporate investment. Previous studies have found that the degree of development of the state-controlled banking system, financial market, and institutional environment will

affect corporate investment and economic growth[8]. This paper examines the impact of the development of digital finance after the deep integration of finance and technology on corporate investment, thus enriching the literature on financial development and corporate investment decision-making. Second, this paper enriches the relevant research on the economic consequences of rapidly developing digital finance. Research on digital finance or financial technology is just emerging. Existing research mainly discusses the impact of digital finance on residents' Entrepreneurship and economic growth, firm technology innovation, industrial structure upgrading traditional bank competition and private lending. This paper enriches the relevant research on the economic consequences of digital finance from the perspective of corporate investment. Thirdly, from the perspective of intangible asset collateral, this paper expands the research on financial constraints and corporate investment. The impact of financing constraints on real firm investment is a very important research issue in the field of finance. Existing studies have mainly investigated the positive effect of fixed asset collateral on alleviating financing constraints [9], while ignoring the change of asset collateral caused by technological progress. This paper finds that the promotion effect of digital finance on corporate investment is more obvious in companies with a high proportion of intangible assets, which preliminarily proves that the effect of intangible asset collateral on reducing corporate financing constraints is applicable.

2. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

In the imperfect market, due to the low level of financial development and weak legal protection for creditors such as banks, the investment level of companies may be restricted by the financing ability, especially for smaller companies. In China's special financial environment, the stock and corporate bond market are small in scale and influence compared with the banking industry for a long time, and the main source of firm financing is still bank credit. The owner discrimination of banks and the incomplete marketization of interest rates have led to the prominent mismatch of financial resources, and the difficulty of firm financing has existed for a long time, which has become an important factor restricting China's economic transformation and upgrading.

A large number of studies have shown that financing constraints are the key factors affecting corporate investment. In recent years, emerging information technologies represented by big data, artificial intelligence and cloud computing have developed rapidly, finance and technology have been deeply integrated, which has a strong impact on traditional finance. With the help of information technology, digital finance can

reduce the financial service threshold, expand the service scope, and improve the risk management ability by enhancing the information collection and analysis ability, so as to finally reduce the resource mismatch problem in traditional finance and alleviate the corporate financing constraints. Specifically, digital finance may alleviate corporate financing constraints and promote the increase of corporate investment through the following three aspects.

First, digital finance can increase the effective allocation of financial resources. Subject to the consideration of technology and profit objectives, traditional financial institutions mainly serve the customer groups with large capital scale and easy coverage of business outlets, and it is difficult to serve the scattered customers with small capital scale. With the help of mobile internet and other communication technologies, digital finance can extend the service scope to any area that can be connected to the internet. In addition, artificial intelligence, big data and other technologies can avoid the increase of business costs associated with the expansion of business scale in traditional finance, greatly reduce the threshold and cost of financial services, and enhance the ability to absorb a large number of scattered investors in the original financial market. Finally, the supply of financial resources will increase.

Secondly, digital finance can more effectively identify and evaluate credit risk. The basic risk of indirect financing dominated by banks is credit risk, and its evaluation mainly depends on a hard index such as firm financial indicators, or on increasing credit through asset collateral, guarantee and other means [10]. Continuous high-frequency trading can better reflect the credit and performance ability of the trading subject. Traditional financial institutions mainly obtain the "hard index" of financial indicators of a firm through annual reports and rating reports, while informal finance can obtain the "soft index" of a firm through geographical relations and business exchanges. Similarly, digital finance can use information technologies such as big data to collect and analyze all kinds of transaction data more efficiently and at a low cost, match other individual characteristic information, and correlate with each other through social network analysis, so as to obtain more "soft index" related to firms, which generate user portraits and evaluate firm credit risks more accurately and comprehensively.

Finally, the competitive effect of digital finance helps to improve the operating efficiency and risk-taking level of traditional financial institutions. The development of digital finance can reduce financial frictions, accelerate the process of market-oriented reform of interest rates, increase the financing cost of banks' liability side, change the debt structure, and improve banks' risk-taking level [11]. In addition, digital finance is the integration of

Finance and technology, with a technology spillover effect. The traditional banking sector can improve the operating efficiency of commercial banks through digital construction. By transforming the factor price system and risk management ability of traditional finance, digital finance forces the transformation and upgrading of traditional finance and breaks the boundary constraints of traditional finance, so as to finally improve the efficiency of financial resource allocation, alleviate the corporate financing constraints and promote corporate investment.

Based on the above analysis, the research hypothesis of this paper is put forward:

H1: The higher the development level of regional digital finance, the higher the level of corporate investment.

3. METHODOLOGY

3.1. Sample selection and data source

The sample consists of Chinese manufacturing private firms listed on Shanghai and Shenzhen stock exchanges between 2011 to 2018. I exclude the firms whose relevant indicators are not comparable. next, I exclude observations with abnormal listing status and firms in the year of IPO. Ultimately, I get the final sample of 8197 observations. Information regarding firms is obtained from the CSMAR and WIND database.

3.2. Variable definition

1) *Dependent Variable*: The dependent variable *Inv* aims to capture the corporate investment level. Following prior studies, *Inv* is measured as Cash paid for purchasing fixed assets, intangible assets and other long-term assets in the cash flow statement divided by its total assets.

2) *Independent Variable*: The independent variable digital financial development index (*Dfi*) is extracted from the Digital Inclusive Finance Index (phase II, 2011-2018) compiled by the digital finance research center of Peking University, which selects 33 specific indicators to describe the development process of digital Finance in China's provincial and prefecture level cities from the three dimensions of digital finance coverage, use depth and digitization degree.

3) *Control Variable*: According to previous research, we control for many other factors that may influence corporate investment. The calculation method of control variables is shown in Table 1.

Table 1. VARIABLE DEFINITION

Variab le	Definition
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Variab le	Definition
<i>Inv</i>	Cash paid for purchasing fixed assets, intangible assets and other long-term assets in the cash flow statement/total assets
<i>Dfi</i>	Digital finance index in <i>Digital Inclusive Finance Index</i>
<i>Size</i>	Natural logarithm of total assets
<i>Roa</i>	Net income divided by total assets
<i>Lev</i>	Total liabilities divided by total assets
<i>Age</i>	Natural logarithm of one plus number of years elapsed since a firm is listed
<i>MB</i>	Book value of total equity divided by market capitalization
<i>Growt h</i>	Rate of increase of the sales income
<i>Tang</i>	Fixed assets divided by total assets
<i>GDP</i>	Rate of increase of Provincial gross domestic product
<i>Ind</i>	Two-digit industrial code dummies
<i>Year</i>	Year fixed effect dummies

3.3. Empirical design

The following model is estimated:

$$Inv_{i,t} = \alpha_0 + \alpha_1 Dfi_{i,t-1} + \alpha_k Controls_{i,t-1} + \varepsilon_{i,t-1} \quad (1)$$

Inv represents the level of corporate investment. *Dfi* denotes the level of regional digital finance development. *Controls* includes all the control variables which are shown in Table 1. ε is an error term. To minimize the effect of outliers, all the continuous variables are winsorized at the top and bottom 1%. The standard errors are heteroscedasticity-adjusted and clustered at the firm and year levels.

4. REGRESSION RESULT

4.1. Summary Statistics

Table 2 presents the descriptive statistical results. It can be seen that the minimum value of *Inv* is 0.1%, and the maximum value is 20.8%, indicating that there are great differences in the investment expenditure level of each company. Similarly, descriptive statistical results of *Dfi* indicate that the level of digital finance development in various regions of China varies greatly from year to year and from region to region.

Table 2. SUMMARY STATISTICS

Variable	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Media n</i>	<i>Max</i>
<i>Inv</i>	8197	0.052	0.044	0.001	0.040	0.208
<i>Dfi</i>	8197	227.47	82.53	28.89	239.86	368.54
<i>Size</i>	8197	21.722	0.989	19.88	21.624	25.383

Variable	N	Mean	SD	Min	Median	Max
				5		
<i>Roa</i>	8197	0.043	0.055	-0.189	0.041	0.193
<i>Lev</i>	8197	0.357	0.182	0.051	0.341	0.875
<i>Cfo</i>	8197	0.043	0.065	-0.144	0.042	0.225
<i>Age</i>	8197	2.729	0.370	1.609	2.773	3.434
<i>MB</i>	8197	2.809	1.776	0.893	2.249	9.971
<i>Growt h</i>	8197	0.202	0.393	-0.449	0.136	2.473
<i>Tang</i>	8197	0.218	0.125	0.019	0.198	0.633
<i>GDP</i>	8197	7.226	0.700	6.600	6.900	9.200

4.2. Digital finance and corporate investment

Table 3 reports the regression results of hypothesis 1. Only industry and year fixed effects are controlled in column (1). The regression coefficient of *Dfi* is 0.0081, and it is significantly positive at the 5% level; Other control variables that may affect corporate investment are added in column (2). The regression coefficient of *Dfi* is 0.0081, and it is significantly positive at the level of 1%, indicating that the development of digital finance has a significant role in promoting firm investment expenditure. From an economic point of view, every increase in the standard deviation of the digital financial index can drive the investment expenditure of firms to increase by 0.67% ($82.53/100 \times 0.038 = 0.00668$), because the average investment expenditure of the company is 0.052, which means that every increase in the standard deviation of the digital financial index will promote the level of firm asset expenditure to rise by 12.85%. It can be seen that the development of digital finance not only has a significant impact on firm investment expenditure in the statistical sense, but also has a certain economic significance. Hypothesis 1 is supported by the empirical results.

Table 3. DIGITAL FINANCE AND CORPORATE INVESTMENT

Variable	<i>Inv</i>	<i>Inv</i>
	(1)	(2)
<i>Dfi</i>	0.0081** (2.325)	0.0081*** (2.588)
<i>Size</i>		0.0013 (1.268)
<i>Roa</i>		0.1220*** (9.921)
<i>Lev</i>		0.0068 (1.482)
<i>Cfo</i>		0.0339*** (3.766)
<i>Age</i>		-0.0116*** (-5.011)
<i>MB</i>		0.0050*** (3.670)

<i>Growth</i>		0.0008' (1.676)
<i>Tang</i>		0.0630*** (9.305)
<i>GDP</i>		0.0154*** (4.558)
<i>_Constant</i>	0.0859*** (10.562)	-0.0839** (-2.037)
<i>Ind</i>	Yes	Yes
<i>Year</i>	Yes	Yes
Adjusted <i>R</i> ²	0.0713	0.1379
<i>N</i>	8197	8197

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. T-values are reported in parentheses.

4.3. Subdivision of Digital Finance Index

The digital finance index used in Table 4 is constructed by synthesizing the secondary indicators of three dimensions of digital finance coverage, using depth and digitization degree through the analytic hierarchy process. The coverage mainly shows that digital finance can break through the geographical restrictions of traditional finance, enhance the ability to reach customers and expand the coverage of financial services. The depth of use mainly measures the actual use of digital financial services such as digital payment and digital credit by financial consumers. The degree of digitization mainly reflects the mobility, convenience and transaction cost of digital financial services. In order to reveal the impact of digital finance on corporate investment in more detail, this paper further analyzes the impact of digital finance development from three subdimensions. The corresponding regression results are reported in Table 4. The coefficient of digital finance coverage breadth (*Dfi-cb*) in column (1) is significantly positive, the coefficient of digital finance use depth (*Dfi-ud*) in column (2) is also significantly positive, and the coefficient of digital finance digitization degree (*Dfi-d*) in column (3) is not significant. These results show that digital finance may be mainly through expanding the coverage of financial services to make up for the shortage of traditional financial supply and improve the depth of financial services to promote the increase of corporate investment.

Table 4. SUBDIVISION OF DIGITAL FINANCE

Variable	<i>Inv</i>	<i>Inv</i>	<i>Inv</i>
	(1)	(2)	(3)
<i>Dfi-cb</i>	0.0062** (2.220)		
<i>Dfi-ud</i>		0.0062** (2.841)	
<i>Dfi-d</i>			-0.0044 (-1.262)
<i>Size</i>	0.0013	0.0014	0.0013

	(1.350)	(1.408)	(1.264)
<i>Roa</i>	0.1333*** (11.198)	0.1325*** (11.118)	0.1336*** (11.222)
<i>Lev</i>	0.0088 ^ˆ (1.934)	0.0089 ^ˆ (1.947)	0.0084 ^ˆ (1.844)
<i>Cfo</i>	0.0305*** (3.361)	0.0297*** (3.271)	0.0320*** (3.539)
<i>Age</i>	-0.0119*** (-5.105)	-0.0118*** (-5.071)	-0.0120*** (-5.164)
<i>MB</i>	0.0009 ^ˆ (1.826)	0.0009 ^ˆ (1.855)	0.0009 ^ˆ (1.789)
<i>Growth</i>	0.0621*** (9.174)	0.0617*** (9.123)	0.0606*** (8.948)
<i>Tang</i>	0.0130*** (4.575)	0.0169*** (9.840)	0.0008 (0.166)
<i>GDP</i>	0.0013 (1.350)	0.0014 (1.408)	0.0013 (1.264)
<i>_Constant</i>	-0.0615 ^ˆ (-1.661)	-0.0995*** (-3.208)	0.0576 (1.069)
<i>Ind</i>	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes
Adjusted R^2	0.1359	0.1367	0.1349
<i>N</i>	8197	8197	8197

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. T-values are reported in parentheses.

4.4. Robust Check

In order to effectively alleviate the possible endogeneity of regression results, I choose the provincial internet penetration rate (*Itar*) as the instrumental variable of digital finance. network communication is the basic condition for financial digitization and interconnection. In particular, the rapid popularization of smartphones and 4G has greatly improved China's Internet penetration rate and laid a good foundation for the development of digital finance. Therefore, the internet penetration rate is closely related to the development of digital finance. At the same time, no research has proved that there is a significant relationship between internet penetration and corporate investment. So internet penetration can be used as an instrumental variable for the development of digital finance. Columns (1) and (2) of Table 5 report the results of a two-stage regression test using internet penetration rate as an instrumental variable. Column (1) reports the regression results between the development level of digital finance and the internet penetration rate. The regression coefficient of *Itar* is significantly positive, indicating that there is a strong correlation between internet penetration rate and digital finance, and that the internet penetration rate meets the correlation requirements of instrumental variables. The results in column (2) show that after using internet penetration rate as the instrumental variable of digital finance development level, there is still a significant positive relationship between the

development of digital finance and corporate investment, which further reduces the concern about endogeneity.

In the previous empirical test, the measurement of the digital finance development level is based on the provincial digital finance index. Columns (3) show the regression results using the digital financial index of prefecture level cities as the independent variable, the coefficient of *Dfi* is significantly positive at the level of 5%, which means the research conclusion is still stable.

Table 5. ROBUST CHECK

Variable	<i>Dfi</i>	<i>Inv</i>	<i>Inv</i>
	(1)	(2)	(3)
<i>Itar</i>	1.1138*** (24.807)		
<i>Dfi</i>		0.0181** (2.124)	0.0090** (2.366)
<i>Size</i>	-0.0045 (-1.068)	0.0020 ^ˆ (1.773)	0.0012 (1.236)
<i>Roa</i>	0.0915 ^ˆ (1.746)	0.1173*** (7.491)	0.1222*** (9.915)
<i>Lev</i>	-0.0320 ^ˆ (-1.717)	0.0037 (0.719)	0.0062 (1.345)
<i>Cfo</i>	0.0524 (1.490)	0.0314*** (3.125)	0.0340*** (3.779)
<i>Age</i>	-0.0042 (-0.513)	-0.0105*** (-4.300)	-0.0115*** (-4.962)
<i>MB</i>	-0.0042 ^ˆ (1.826)	0.0008 (1.478)	0.0008 (1.628)
<i>Growth</i>	-0.0080 ^ˆ (-1.791)	0.0050*** (3.362)	0.0051*** (3.715)
<i>Tang</i>	0.0406 ^ˆ (1.673)	0.0597*** (8.173)	0.0636*** (9.346)
<i>GDP</i>	-0.6870*** (-229.837)	0.0279 (3.327)	0.0137*** (4.632)
<i>_Constant</i>	6.2357*** (55.619)	-0.2146** (-2.543)	-0.0696 ^ˆ (-1.797)
<i>Ind</i>	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes
Adjusted R^2	0.7233	0.1372	0.1376
<i>N</i>	6716	6716	8197

Notes: The internet penetration rate comes from the *Statistical Report On the Development Of China's Internet Network* issued by China Internet Network Center. Since the internet penetration rate of each province was not disclosed in 2018, the number of samples was reduced to 6716. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. T-values are reported in parentheses.

5. HETEROGENEITY ANALYSIS

5.1. Intangible asset collateral

Digital finance can use big data, artificial intelligence and other technologies to mine the relevant information of intangible assets of firms, and automatically form value evaluation reports, so as to alleviate the financing constraints of firms and promote corporate investment by

enhancing the intangible asset collateral. Therefore, according to the annual average of the proportion of intangible assets of the firms, the samples are divided into two groups: high and low proportion of intangible assets. The results are shown in Columns (1) and (2) of Table 6. Among the firms with a high proportion of intangible assets, the regression coefficient of Dfi is significantly positive. In firms with low intangible assets, the coefficient of Dfi is smaller and does not have statistical significance. This result shows that the development of digital finance can effectively alleviate the serious dependence of traditional finance dominated by banks on tangible asset collateral in the credit process, and then promote the increase of corporate investment.

Table 6. HETEROGENEITY ANALYSIS

Variable	Proportion of Intangible Assets		Development Of Traditional Finance	
	Low	High	Low	High
	<i>Inv</i>	<i>Inv</i>	<i>Inv</i>	<i>Inv</i>
	(1)	(2)	(3)	(4)
<i>Dfi</i>	-0.0003 (-0.076)	0.0167*** (4.244)	0.0137** (2.093)	0.0030 (0.683)
<i>Size</i>	0.0017 (1.329)	0.0013 (0.974)	0.0034** (2.476)	-0.0004 (-0.297)
<i>Roa</i>	0.1199*** (7.500)	0.1308*** (7.855)	0.1199*** (6.836)	0.1225*** (7.469)
<i>Lev</i>	0.0108 [†] (1.753)	-0.0001 (-0.010)	0.0098 (1.541)	0.0042 (0.632)
<i>Cfo</i>	0.0252** (2.086)	0.0445*** (3.528)	0.0319*** (2.608)	0.0327*** (2.612)
<i>Age</i>	- 0.0146*** (-4.686)	- 0.0077*** (-2.629)	- 0.0141*** (-4.002)	- 0.0105*** (-3.598)
<i>MB</i>	0.0005 (0.730)	0.0013* (1.880)	0.0015** (2.005)	0.0005 (0.787)
<i>Growth</i>	0.0057*** (2.964)	0.0035 [†] (1.864)	0.0046** (2.296)	0.0049*** (2.583)
<i>Tang</i>	0.0809*** (8.331)	0.0365*** (4.294)	0.0445*** (4.907)	0.0739*** (7.609)
<i>GDP</i>	0.0064 (1.395)	0.0247*** (5.748)	0.0223*** (3.215)	0.0092 [†] (1.927)
<i>_Constant</i>	-0.0002 (-0.004)	-0.1769*** (-3.415)	-0.1832** (-2.336)	0.0085 (0.148)
<i>Ind</i>	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes
Adjusted R^2	0.1505	0.1391	0.1655	0.1359
<i>N</i>	4102	4095	3817	4380

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. T -values are reported in parentheses.

5.2. Traditional financial development

Digital finance is complementary to traditional finance. This paper carries out grouping regression according to the median regional traditional financial development level and uses the ratio of total loans to GDP to measure. The results in Columns (3) and (4) of Table 6 show that digital finance can be used as a supplement to the development of traditional finance,

better serve the financing needs of enterprises and promote the improvement of enterprise investment levels.

6. CONCLUSION

Based on Chinese manufacturing private listed firms, this paper found that the development of digital finance helps to improve the level of corporate investment. From the perspective of subdivision dimensions, the coverage and use depth of digital finance have a significant positive role in promoting corporate investment compared to the digital finance digitization degree has no significant role. In heterogeneity analysis, it is also found that the promotion effect of digital finance on private firms' investment is more significant in a high proportion of intangible assets and in areas with weak traditional financial development levels.

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