Proceedings of the 2nd International Conference on Financial Technology and Business Analysis
DOI: 10.54254/2754-1169/73/20231506

Digital Financial Inclusion and Enterprise Technological Innovation

Ting Yang[1,a,*]

[1]*Zhuhai College of Jilin University, Caotang, Jinwan District, Zhuhai City, Guangdong Province, P.R.China*
a. gloriaa_yt@Foxmail.com
**corresponding author*

Abstract: This study investigates how SMEs' creative activities are impacted by digital financial inclusion. Small and medium-sized businesses face severe funding constraints, and scientific and technical innovation struggles to advance quickly due to information asymmetry, regional development imbalance, and other issues. The dominating element of the current growth of inclusive finance, digital inclusive finance, may address these concerns through theoretical and empirical research. Despite the fact that digital inclusive finance is still in its infancy and that there are issues with the law, risk management, trust, and other areas, accelerating the development of digital inclusive finance, easing the financial restrictions on SMEs, and enhancing the drive for scientific and technological innovation can all help to promote the innovative development of SMEs. Based on the influence of SMEs' technology innovation from the perspective of digital inclusive finance, this paper analyzes the influence of technology innovation by using the multiple linear regression model of time series. Empirical analysis shows that the digitalization of digital inclusive finance has a significant positive impact on small and medium-sized enterprises' scientific and technological innovation, significantly the higher the digital support and coverage breadth index, the more pronounced the incentive of scientific and technological innovation. Considering the impact of regional differences, the paper puts forward relevant policy suggestions, including improving laws and supervision, establishing a mature credit investigation system, and strengthening risk management and the digital divide. Through these measures, digital inclusive finance can better support the financing and development of SMEs and promote scientific and technological innovation and the development of the national economy.

Keywords: Digital inclusive finance, SME financing supply chain finance, innovation driven

1. Research background and study significance

As the vast majority of the total number of Chinese enterprises, small and medium-sized enterprises' scientific and technological innovation ability plays a decisive role in national innovation and development. However, China's financial system is imperfect, and SMEs have narrow financing channels, high cost, and low efficiency, which have become the biggest obstacle to scientific and technological innovation. Digital inclusive financing is becoming the standard thanks to the present progress of inclusive finance. But there are still lots of issues with financial inclusion via digital means.

DOI: 10.54254/2754-1169/73/20231506

First, China's digital financial inclusion is in its infancy, and relevant laws must be improved. The challenges of risk management, digital divide, infrastructure, and regulatory adaptability must be solved. Second, the problem of digitally inclusive financial terminals needs to be solved, and SMEs lack the motivation for self-technological innovation. Although the current digital inclusive finance has somewhat increased the likelihood that small and medium-sized businesses will be able to secure financing, before applying funds for technology research and development, small and medium-sized enterprises must first address the underlying issue.

Therefore, we need to think about how to stimulate SMEs themselves to generate ideas of scientific and technological innovation, better protect the interests of investors, and help digital inclusive finance run on the typical track.

Digital inclusive finance is important to promote scientific and technological innovation in China. However, in this study, the impact of digital financial inclusion also strengthens the policy's authority, raises public awareness, and enhances the system for digital financial inclusion[1].

2. Definition of relevant concepts

In the 2005 UN "International Year of Microfinance" press, the idea of inclusive financing was promoted. Which means it can provide all-round, convenient, providing efficient financial services to all societal groupings and classifications. In contrast to traditional inclusive finance, digital inclusive finance's operating principle refers to enhancing the effectiveness and range of financial services through the use of digital technologies, such as cloud computing, mobile payment, Internet communication, and big data[2]. One of the key components of building the socialist modern financial system with Chinese characteristics in the new era is the development of digital inclusive finance.

In 2011, China's classification standards for classifying large, small, medium, and micro enterprises were jointly issued by the National Bureau of Statistics, the National Development and Reform Commission, the Ministry of Finance[3], and other departments. In terms of the division and definition of small and medium-sized enterprises in China, it is not difficult to find that the scale advantages of small and medium-sized enterprises can be highly summarized as small scale, flexible operation means, and strong adaptability to the market[4]. Compared with large enterprises, SMEs are more flexible in personnel arrangement and production management, which is conducive to improving work efficiency; their flexibility, openness, and inclusiveness are conducive to the innovation and development of new products and technologies.

3. Theoretical analysis and research hypothesis

Adapting to the current economic situation is complex, and the digitalization of inclusive finance is necessary for in-depth development. The following two ways that the digitization of inclusive finance may impact SMEs' technical innovation.

Digital efficiency promotes the improvement of inclusive financial coverage and expands the scope of small and medium-sized enterprises. Its high efficiency is demonstrated by the accuracy and efficacy of enterprise credit information, the ease with which the examination and approval process is carried out, and the low cost of both information and transactions, all of which serve to effectively encourage the development of new financing technologies by small and medium-sized businesses.

Therefore, hypothesis H1: Small and medium-sized businesses' technical innovation is significantly benefited by the digitization of inclusive digital finance. The incentive for scientific and technical innovation is stronger the higher the digital support and coverage breadth score..

The financing of SMEs is affected not only by their factors but also by the banking service model and the social credit system. Digital inclusive finance has brought new prospects for developing and financing small and medium-sized enterprises, which positively promotes the following two aspects.

DOI: 10.54254/2754-1169/73/20231506

Digital inclusive finance can improve SMEs' financial obstacles and alleviate information asymmetry in financial services. The imperfect management system and insufficient adequate information make it difficult for SMEs to obtain funds for technological innovation, which significantly improves the efficiency of capital financing and alleviates the information asymmetry of financial services. Therefore, hypothesis H2: Digital inclusive finance effectively relieves innovation constraints, enhances innovation financing efficiency, and thus promotes the innovation output of SMEs.

4. Research design

4.1. Model setting and variable measurement

4.1.1. Model Setting

This study explores the impact of digital inclusive finance on small- and medium-sized businesses' technological innovation from the standpoint of several different elements. In this paper, EViews multiple linear regression model is used, and the model is set as follows:

$$Patent = c + \alpha DFcf + \beta DCcf + \gamma DScf + X\mathrm{e} \quad (1)$$

The explained variable is one of them. The number of patents a firm generates as a result of its technological innovation output is represented by the number of patents; this makes small and medium-sized businesses' capacity for technological innovation more apparent. The core explanatory variable DFcf represents the interaction item of digital total financial inclusion index and net cash flow of operating activities (TTM). Similarly, it further examines the impact of each dimension of digital financial inclusion on technological innovation, including the breadth of coverage and net cash flow interaction item (DCcf) and digital support service degree and net cash flow interaction item (DScf); the interaction processing of net cash flow product is that considering the technological innovation ability of the enterprise itself; X is the proportion of the total R & D expenditure to the operating income of enterprises. In addition, since it takes some time for enterprises to develop technological innovation patent products, this paper lags all explanatory variables in one phase. The advantage of this is that it can reduce the endogenous interference caused by reverse causation. Specific definitions of the variables involved in the model are shown in Table Table 1.

Table 1: Variable definitions

type of variable	Variable name	Variable meaning	variable declaration
explained variable	Patent	Patent number	Annual number of patents of the enterprise
explanatory variable	DFcf	Interaction items between digital financial inclusion total index, coverage breadth index and digital support service degree index and net cash flow respectively	Last year Digital Financial Inclusion Total Index (Peking University Digital Financial Inclusion Index) [6] * Net cash flow for the year
	DCcf		Last year coverage breadth index (bid.) * Net cash flow for the year
	DScf		Last year (id.) * Net cash flow for the year
controlled variable	cf	Net cash flow	Net cash flow generated from operating activities
	size	scale	Scale classification of small and medium-sized enterprises
Heterogeneity test	X	RESEARCH and development expenditure	R & D expenditure / total operating revenue

DOI: 10.54254/2754-1169/73/20231506

4.1.2. Sample selection and data source

This study examines the stimulating impact of digital inclusive finance development on the technical innovation of SMEs using data from prefecture-level cities[5]. First of all, the scope of sample small and medium-sized enterprises is selected, considering the difficulty of collecting data and the definition of small and medium-sized enterprises in relevant literature, the relevant data of listed companies on the GEM and the science and Technology Innovation Board are selected, and this paper intends to select the scattered sample set in the location of enterprises. Secondly, the number of patents of listed SMEs is selected by the variable from 2015-2022. The patent number is the concentrated embodiment of the technological innovation index of enterprises. The patent data comes from the State Intellectual Property Office and the patent application date; finally, the relevant data of the enterprise comes from wind and prospective database, and the samples of listed companies in the financial and real estate industries are excluded. The Peking University Digital Inclusive Finance Index (2011–2021) [6], published by the Peking University Digital Research Center, includes statistics on digital inclusive finance at the prefecture and city levels that are relevant to data on businesses. The index value of each city in 2020 is selected, and the construction principles, index selection and compilation methods of the index will not be described here.

Table 2: The variables describe the statistical results

name of index	The number of cases	mean	standard deviations
Scientific and technological innovation indicators			
Patent number	693	256.32	283.41
Number of R & D personnel	693	243.59	182.79
The proportion of r & d personnel	693	20.11	25.19
R & D investment (billion yuan)	693	1769.09	989.99
The proportion of R & D investment in operating revenue	693	9.08	4.94
research and development expenditure	693	6407700	1658211
Business indicators			
cash flow	693	154.82	145.43
The Digital Financial Inclusion Index			
combined index	693	183.44	19.75
Digital financial inclusion breadth	693	184.27	27.63
Digital financial inclusion depth	693	179.35	20.91
Digital digitization of digital inclusive finance	693	188.15	7.86

4.1.3. Endogenous effects

Problem with reverse causality: In this situation, there may be some interaction between enterprise technology innovation and digital financial inclusion. In other words, while corporate innovation activities may support the growth of digital inclusive finance, the latter may be supported by enterprise technology innovation.

To address this issue, we must appropriately treat all the explanatory variables when performing the regression analyses. To lessen the impact of reverse causation problems, we will employ the enterprise-related variables, the enterprise innovation indicator, and the digital financial inclusion index for the years 2014 through 2021. We may make insightful recommendations for future policies

DOI: 10.54254/2754-1169/73/20231506

using this data to better understand the connection between enterprise technology innovation and digital financial inclusion.

4.2. Regression analysis of the empirical results

4.2.1. Benchmark regression results

The effect of the digital financial inclusion index on the technological innovation of SMEs is seen in Table 2. The findings reveal that, at a statistical threshold of 5%, the estimated DCcf is significantly positive, suggesting that the growth of digital financial inclusion can help SMEs become more technologically innovative. As a preliminary robustness test, this paper also examines the impact of the two dimensions (coverage breadth and the degree of digital support services) of the digital financial inclusion index on the technological innovation of SMEs[7]. The estimated results are shown in Table 3, line (4) - (5). The results show that the three dimensions have a significant role in promoting SMEs' scientific and technological innovation. Specifically, with the increase of the coverage of digital inclusive finance and the improvement of digital support services, SMEs' scientific and technological innovation will be improved. The estimation result of control variables shows that the proportion of enterprise R & D significantly positively impacts the acquisition of scientific and technological innovation.

Table 3: Multiple regression benchmark Results (SMEs)

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	19.88	5.707578	2.910212	0.0044
DCcf	465.87	2.13E-08	-1.448287	0.0004
DFcf	8.70E-08	5.72E-08	1.521603	0.0010
DScf	5.34E-08	3.75E-08	-1.425243	0.0069
X	21.83188	6.250941	3.492574	0.0007
R-squared	0.63	Mean dependent var		23.99
Adjusted R-squared	0.73	S.D.dependent var		47.96
S.E.of regression	16.46	Akaike info criterion		15.56
Sum squared resid	4658.33	Schwarz criterion		25.98
Log likelihood	327.46	Hannan-Quinn criter.		35.61
F-statistic	4.45	Durbin-Watson stat		5.98
Prob(F-statistic)	0.00			

4.2.2. Heterogeneity test

The emergence of digital inclusive finance makes compensate for the shortcomings of the traditional financial system[8]. By utilizing digital technology, it offers more adaptable and practical financing options for unique groups including small and medium-sized businesses and underdeveloped areas, successfully encouraging the scientific and technological innovation of businesses. In order to better understand the impact effect of digital inclusive finance in different regions and under different enterprise sizes, this paper will discuss the impact of different regions and enterprise sizes on the technological innovation of small and medium-sized enterprises using empirical test.

We will use data from the enterprise technological innovation index and various Chinese provinces' enterprise technological development data to estimate the impact of the development of digital financial inclusion on SME technological innovation in various regions.

DOI: 10.54254/2754-1169/73/20231506

Table 4: Results of heterogeneity analysis (regional distribution)

variable	(1)Eastern developed areas	(2) Less developed western areas	(3) Group differences
$DCcf$	0.499^{***}(0.087)	0.337^{*}(0.354)	0.997^{***}(0.250)
$DCcf * SOE$			0.214^{***}(0.303)
controlled variable	control	control	control
Annual fixed effect	control	control	control
N	277	242	174
$Pseudo\ R^2$	0.096	0.467	0.357

pour:* , **And***Represents represent significant at 10%, 5% and 1% levels, respectively.

5. Policy Recommendations

In order to further support the role of digital inclusive financing in encouraging the technological innovation of SMEs, we propose the following ideas in light of the aforementioned conclusions[8].

First, according to the conclusion of heterogeneity analysis, towns and areas in the west and major sites have a more significant effect on digital inclusive finance. At the same time, increasing the availability of digital inclusive finance in the area can benefit growth as more small and medium-sized businesses in the region want assistance. To increase the availability of digital inclusive finance in the central and western regions, the nation must upgrade the pertinent legal framework.

6. Conclusion

This essay elaborates on how digital Pratt & Whitney financing affects technological innovation by small and medium-sized businesses. Based on the cities in 2014-2021 and 2014-2021, the panel data, from the perspective of multiple factors, the EViews multiple linear regression model empirically analyzes the digital Pratt & Whitney finance influence of small and medium-sized enterprise technology innovation and regional heterogeneity. The conclusion is drawn as follows:

First, the growth of digital inclusive finance has the potential to encourage small and medium-sized businesses to innovate more on the scientific and technology front. Second, the increase of financial coverage breadth and net cash flow of digital financial inclusion and the degree of digital support services and net cash flow (DScf) can improve the level of technological innovation of small and medium-sized enterprises[8]. At the same time, the latter plays a weaker role than the former. Third, the growth of digital inclusive finance has considerably benefited the cities and regions in central and western China with limited innovation ability and relatively poor starting factor endowment circumstances, according to the heterogeneity analysis, which also reveals this.

References

[1] *Xianpu Xu, Yuxi Yang. "RETRACTED: Can Digital Financial Inclusion Help Reduce Urban Crime? Evidence from Chinese Criminal Judgment on Theft Cases", Systems, 2023*

[2] *Chien-Chiang Lee, Manting Tang, Chi-Chuan Lee. "Reaping digital dividends: Digital inclusive finance and high-quality development of enterprises in China",Telecommunications Policy, 2022*

[3] *Bei Duoguang,Mo Xiugen.China Financial Inclusion Development Report (2019)[M].Beijing:China Finance Press,2019.10*

[4] *Yang Liu, Lin Luan, Weilong Wu, Zhiqiang Zhang, Yen Hsu. "Can digital financial inclusion promote China's economic growth?", International Review of Financial Analysis, 2021*

[5] *Yuting Shi, Qiuwang Cheng, Yizhen Wu,Qiaohua Lin, Anxin Xu, Qiujin Zheng."Promoting or Inhibiting? Digital Inclusive Finance and Cultural Consumption of Rural Residents", Sustainability, 2023*

DOI: 10.54254/2754-1169/73/20231506

[6] *GUO Feng, WANG Jingyi, WANG Fang, KONG Tao, ZHANG Xun, CHENG Zhiyun, "Measuring China's Digital Financial Inclusion: Index Compilation and Spatial Characteristics", China Economic Quarterly, 2020,19(4),1401-1418.*

[7] *Zitian Fu, Yujiao Zhou, Weifeng Li, Kaiyang Zhong. "Impact of digital finance on energy efficiency: empirical findings from China",Environmental Science and Pollution Research, 2022*

[8] *Wenqi Li, Wenbin Pang. "Digital inclusive finance, financial mismatch and the innovation capacity of small and medium sized enterprises: Evidence from Chinese listed companies", Heliyon, 2023*