The Impact of Digital Inclusive Financial Development on Corporate R&D Investment in Fujian Province

ABSTRACT

Against the background of the rapid development of information technology and the wide application of the Internet, digital inclusive finance has become a key source of credit funds and an important force in promoting economic growth in China. This paper explores how the development of digital inclusive finance affects the R&D investment of enterprises. This paper takes 171 listed companies in Fujian Province as the research samples during the period from 2016 to 2021 and constructs a panel data fixed effect model to study the impact of digital financial inclusion on enterprises' R&D investment. The digital inclusive finance is selected from the city-level digital finance index released by the Digital Finance Research Center of Peking University, and the data on corporate R&D investment is derived from the relevant indexes in the database of listed companies of GuotaiAn to ensure the accuracy and reliability of the research results.

The results of the study show that the development level of digital inclusive finance has a positive relationship with the R&D investment of enterprises and that digital inclusive finance can positively affect the liquid assets of enterprises by enhancing the liquidity of enterprises, thus promoting the increase of innovative R&D investmsent of enterprises. Through data analysis, it is found that the impact of digital inclusive finance on enterprise innovation R&D investment has a certain lag, and the impact is more significant in the case of lagging. This finding provides empirical support for enterprise innovation and points out the important role of digital inclusive finance in promoting enterprise innovation. The country should vigorously develop digital inclusive finance and explore sustainable business models, thereby promoting the acceptance of digitization in the traditional financial industry and facilitating digital transformation. At the same time, firms should be encouraged to enhance corporate innovation through the effective use of digitally inclusive resources and to strengthen the identification and management of risks, thereby facilitating innovation and development.

Keywords:Digital financial inclusion, R&D investment, Fujian Province listed companies, Fixed-effects modeling

1.INTRODUCTION

With the rapid development and popularization of digital technology, digital inclusive finance is developing rapidly worldwide. In the report of the Twentieth Party Congress, it is proposed to accelerate the development of the digital economy, promote the integrated development of the real economy, and create several internationally competitive digital industry clusters. Digital financial inclusion is a new topic that has attracted much attention in recent years and has gradually become a powerful force in promoting China's financial development and financial system change.

Through a range of technologies such as cloud computing, data communications, information processing, and big data analytics, digital financial inclusion can effectively reduce costs and bring more economic benefits and efficiencies to users in the process of services and transactions. This has greatly facilitated access to financial resources for all types of economies, including MSMEs and startups. This trend not only has far-reaching implications for economic growth and social development but also provides unprecedented opportunities for enterprises, especially technology-based enterprises, to gain easier access to the financial support needed for research and development (R&D), thereby increasing R&D investment and promoting technological innovation and product upgrading.

Today, with the high degree of global economic integration and the continuous advancement of digital technology, understanding and grasping the impact of digital financial inclusion on corporate R&D investment is of great theoretical and practical significance for policymakers, corporate managers, and investors. On the one hand, it helps policymakers to design more effective policy measures to promote financial inclusion and technological innovation, and to promote sustainable and healthy economic development; on the other hand, it provides an important basis for business managers and investors to gain insight into future trends and make strategic decisions.

The purpose of this project is to explore the mechanism of digital inclusive finance on enterprises' R&D investment, especially how to encourage enterprises to increase their investment in R&D by improving their access to capital, reducing financing costs, and improving financing efficiency, thus accelerating their pace of innovation and enhancing their

market competitiveness. In this process, this paper will analyze the current situation of the development of digital inclusive finance, the changing trend of enterprise R&D investment, as well as the interaction and influence mechanism between the two.

1.1 Background And Significance Of The Study

China is in a phase of rapid development, and its economic and financial systems are undergoing great changes. Against this background, the development of digital inclusive finance is both an opportunity for technological development and an important initiative for China to promote inclusive finance, support the real economy, and implement its innovation-driven development strategy. As China's economy enters a new normal, the rate of economic growth has shifted from high-speed growth to the stage of high-quality development, and the adjustment and optimization of economic structure has become an inevitable trend.

In recent years, China has made remarkable progress in the field of science and technology innovation, and its ever-increasing innovation capacity has become a key driving force for the country's sustained development. Enterprise R&D investment, as an important part of innovation activities, is of great significance in promoting the transformation and upgrading of economic structure and enhancing industrial competitiveness. In recent years, the government has continuously emphasized the importance of financial services for the real economy, especially for small and medium-sized enterprises (SMEs) and science and technology innovation enterprises. However, enterprise innovation projects are longer, with higher risks and higher capital needs, and it is difficult for a company's funds to meet its needs for innovation, and the traditional financial system often struggles to meet the financing needs of these enterprises for various reasons, such as risk assessment mechanisms and collateralized lending requirements. The rise of digital inclusive finance provides a new path to address this issue.

With the rapid development and popularization of digital technologies such as the Internet, big data, and artificial intelligence, the digital economy has become a new round of economic growth in China. The Chinese government has taken a proactive attitude in promoting financial reform and innovation and has introduced several policies to support the development of fintech, to improve the efficiency and popularization of financial services through technological means. Digital financial inclusion

has developed against this technological backdrop, lowering the threshold and cost of financial services through technological means, improving the efficiency and coverage of financial services, and promoting financial popularization and inclusion.

At the same time, digital inclusive finance helps to narrow the income gap by providing financial services to a wide range of small and medium-sized enterprises (SMEs), entrepreneurs, and low-income groups, which promotes social fairness and justice and realizes the rational distribution and redistribution of wealth. The promotion of digital inclusive finance also plays an important role in fostering competition and vitality in the financial market, by incentivizing traditional financial institutions and fintech companies to innovate financial products and services and improve their market competitiveness. Such competition can drive the entire financial industry towards greater efficiency and transparency.

Therefore, the study of digital inclusive finance not only has an important impact on promoting the modernization of China's financial sector and the development of the national economy but also has far-reaching significance in achieving social equity and the well-being of all people.

1.2 Research content and innovations

Digital financial inclusion has become a focus of academic attention, and existing research has mainly focused on macroeconomic growth, narrowing the gap between the rich and the poor, and promoting residents' consumption, while there is a lack of research on financial inclusion at the enterprise level. Based on the above background, this study aims to explore the impact of digital inclusive finance on enterprise R&D investment and analyze how it affects the R&D investment of enterprises, especially small and medium-sized enterprises (SMEs) and science and technology innovative enterprises (STIEs), by providing financial support and lowering the cost of financing in the context of the rapid development of digital inclusive finance. This study analyzed the collected data by constructing a fixed-effects model and using regression analysis to explore the impact of digital inclusive finance on enterprises' innovative R&D capital investment and to study the mediating role played by enterprises' liquid assets between digital inclusive finance and enterprises' R&D investment. The lag analysis is conducted to examine whether the impact of digital inclusive finance on enterprises' innovative R&D investment has a certain lag. Based on the above research, the data are tested for heterogeneity and it is discussed whether the

development of digital inclusive finance can significantly promote the R&D investment of state-owned enterprises.

This paper analyzes how digital financial inclusion affects corporate R&D investment through empirical research and analysis. By theoretically constructing hypotheses, combining the financial data of 171 listed companies in Fujian Province with the digital financial inclusion index, constructing a fixed effect model for regression analysis, and performing heterogeneity analysis on the obtained data. This topic intends to examine the impact of digital financial inclusion on corporate R&D investment from multiple dimensions and perspectives and verify the stability of the model by replacing the explanatory variables, to ensure the authenticity and reliability of the research results. We hope to explore the intrinsic connection between digital inclusive finance and the R&D investment of enterprises, provide a scientific basis for the formulation and implementation of relevant policies, provide guidance and support for the development of enterprises, especially small and medium-sized enterprises (SMEs) and scientific and technological innovative enterprises, and then contribute to the promotion of high-quality development of China's economy.

2.LITERATURE REVIEW

2.1 Current status of domestic and international research on digital financial inclusion

At present, each enterprise is facing the problem of innovative development, due to the constraints of traditional finance, resulting in several similar financing difficulties, regional differences, and other types of obstacles, and it is difficult to break through in the current situation, therefore, the combination of emerging technologies and financial development should come into being is the digital financial inclusion. Chi Lihua and other scholars (2023) believe that the development of industries centered on the digital economy has become an important pillar of the global economic system. [1]Nowadays, whether digital inclusive finance can be organically integrated with the enterprise structure has become one of the important factors influencing its international competitiveness, and digital inclusive finance, as an emerging field that has been developing rapidly in recent years, has gained widespread attention around the world, and some foreign scholars say that digital inclusive finance, thanks to the characteristics of its digital

technology, makes the information of both sides of the credit more transparent, thus enabling the traditional financial system to be reformed and innovated. get reform and innovation. [2]Of course, the topic of digital inclusive finance in China is also very hot, the party's twentieth report also pointed out: "Innovation is the first power, in-depth implementation of the innovation-driven development strategy, to open up new areas of development of new track, and constantly shaping the development of new kinetic energy and new advantages", and to promote the innovation and development of enterprises, the government of our country has begun to vigorously implement the To promote the innovative development of enterprises, China's government has also begun to vigorously implement digital inclusive finance, Lai Liqi et al. (2023) study that digital inclusive finance has the characteristics of "wide range, low cost, and high efficiency", which can help enterprises to further open up the financing channels, and inject impetus into the innovative development of enterprises. [3]China's digital inclusive finance is now in the peak period of development, and all industries and enterprises are facing the urgent need to break through the bottleneck of the development of the problem, how to develop digital inclusive finance to obtain more R & D funds to promote the innovative development of enterprises, is the domestic industries need to solve the problem.

2.2 Study on problems faced by enterprises in innovation and bottlenecks in development

Before discussing the difficulties of enterprise innovation, enterprise creation is already a huge problem, as can be seen from the "China Enterprise Growth Report 2021", many enterprises and many projects have had difficulty surviving for a long time, and enterprise survival requires a certain degree of competitiveness, and such competitiveness is derived from enterprise innovation. In addition to the lack of scale and experience, the bigger reason is that their resource constraints are more severe, that is, the lack of capital.[4] "Financing is difficult and expensive" is common in all enterprises, but start-ups are more likely to fall into a cash flow crisis in the face of such a problem so that they can't continue to operate leading to bankruptcy and closure.[5] Similarly, mature enterprises that have accumulated too many burdens or can't find a breakthrough are more likely to fall into cash flow crises, thus leading to bankruptcy. Similarly, mature companies that have accumulated too many burdens or have failed to find a breakthrough point may also face the problem of survival. In addition, in recent years, due to the new crown epidemic and other factors that can cause a major blow to the

international economic environment, many enterprises have had difficulty resisting the blow of the economic crisis, China's small and medium-sized enterprises are also facing great difficulties in enterprise development, Guo Mengyuan (2023) in his research statistics, found that small and medium-sized enterprises have access to financial resources accounted for only a quarter of the total financial resources, far less than its contribution to the economy, to a certain extent, inhibit enterprises in the technology development and development of enterprises. To a certain extent, it inhibits the investment of enterprises in technological innovation. [6]*It can be seen that one of the biggest problems faced by enterprises in innovation is the problem of finance, either due to insufficient funds or lack of motivation.*

Currently, the development of the Internet, digital finance, and other technologies signifies that the world has entered the Internet era, and all industries have begun to transform through the combination of digital information technology. However, Hu Bing et al. (2023) study pointed out that the digital transformation of Chinese enterprises is still in the exploration period, the transformation of successful enterprises accounted for only 16%, and even some enterprises "will not turn", "no money to turn" and "dare not turn" and other phenomena, resulting in digital finance and the real economy. The phenomenon of "not knowing how to turn", "not having the money to turn" and "not daring to turn" has led to the difficulty of realizing the in-depth integration of digital finance and the real economy, as well as the problem of information asymmetry between investment and financing subjects, high agency costs and excessive rent-seeking space for the management, and so on, which still exists. [7]*These problems should be solved first if we want to increase the R&D capital of enterprises through the development of digital inclusive finance.*

2.3 Mechanisms of the impact of digital financial inclusion on business innovation

Based on the summary and analysis of the literature, this paper concludes that the mechanism of the impact of digital inclusive finance on enterprise innovation is mainly divided into the following three kinds: alleviating the enterprise financing constraints, reducing the cost of enterprise innovation, and improving the confidence of enterprise innovation.

[1]1. Alleviating corporate finance constraints

Digital financial inclusion can firstly bring more capital investment for enterprises by broadening financing channels, digital financial inclusion can reduce the threshold of financing, the continuous development of Internet technology has brought new changes to traditional finance, especially digital financial inclusion with its broadness and universality, so that more small and medium-sized micro-groups benefit from it to obtain more comprehensive financial services, and also greatly reduces the threshold of enterprise financing, so that the level of entrepreneurship can be enhanced. The level of entrepreneurship can be improved;[8] *Secondly, digital inclusive finance can improve financing efficiency, by simplifying the process and procedures of financial services, it provides enterprises with a brand new financial service business, and the willingness to finance and invest parties to reach cooperation is stronger, and the drawbacks of the traditional financial institutions' service model can be solved, to increase the innovation output of enterprises.*

[2]2. Reducing the cost of innovation for enterprises

Digital inclusive finance with the help of big data, cloud computing, and other new digital information technology, improves the efficiency of information screening, greatly reducing the cost of the process, in addition, can be evaluated through the information assessment of the enterprise prospects, projected returns, etc., for innovation to bring more financial support, and with financial support will be able to continue to increase investment in research and development to promote the development of finance, to supervise the enterprise internal The use of funds can improve the utilization rate of funds and achieve the effect of reducing management costs.[9]

[3]

[4]3. Improving business confidence in innovation

Many enterprises have a conservative attitude towards increasing their investment in innovation and R&D, not only because of insufficient funds but also because of their uncertainty and therefore lack of confidence in innovation. Insufficient funds can be reduced through the aforementioned level of financing constraints to get a certain degree of relief, and uncertainty comes from the asymmetry of information, this problem can also be solved with the help of digital financial inclusion technology, digital financial inclusion or relying on the technology of its big data to carry out a wide range of large-scale information integration and processing, to provide objective analysis and evaluation of the various

situations, objective and fair risk assessment can provide more business information for The objective and fair risk assessment can provide more enterprise information for enterprise investors, which is convenient for them to understand the operation of the enterprise, thus reducing the information asymmetry between outsiders and enterprises, and alleviating the financing constraints.[10] This point is mentioned in the research of Wang et al. (2022). And because enterprise innovation is always accompanied by higher risks, financial institutions will raise the loan threshold for security reasons to increase the control of loan risks, so that although it will reduce the possibility of risk generation, it undoubtedly reduces the source of funds, but through the advantages of digital inclusive finance to alleviate the asymmetry of information, financial institutions can increase the degree of control of risk, and enterprises can also get more quality services.

2.4 Study on the relationship between digital financial inclusion and corporate investment in innovation and R&D

With the extensive implementation and development of digital information technology in the financial field, scholars at home and abroad have a high degree of concern about it, many scholars have different views on the factors affecting the enterprise's innovation and R & D investment, which can be divided into two parts of the external and internal factors, for example, some scholars believe that external factors are conducive to the introduction of intellectual property rights and similar laws and regulations to increase the innovation and R & D investment of the enterprise. R&D investment[11], while some scholars believe that the internal factors are related to the level of corporate governance. Because of this, digital financial inclusion can have a positive impact on both internal and external factors thanks to its sufficient depth of use and breadth of coverage. In recent years, information about digital financial inclusion has appeared in many research papers, and how enterprises can make innovation breakthroughs in new fields is also a hot topic, by summarizing and analyzing the relevant research results, it can be found that most of the scholars' research conclusions It shows that digital financial inclusion basically has a significant positive impact on enterprise innovation, and digital financial inclusion is positively correlated with all aspects of enterprise innovation. In the research conclusions of Pan Yaru et al. (2023), it is shown that the impact of digital financial inclusion can be extended to the whole economy, and it has a very obvious positive function for the economic development of the region. The study shows that China's central and eastern economic impact is very significant,

while the western part is less significant,[12] shows that the influence of digital financial inclusion still has certain limitations, in enterprise innovation and R & D investment has also been shown, specifically for the lower level of marketization, the economic level of the backward areas of the enterprise impact is not significant.

2.5 Literature review of the impact of digital financial inclusion on firms' investment in innovation and R&D

To summarize, the insights into the impact of digital inclusive finance on firms' innovative R&D investment are mainly divided into two aspects: policy recommendations and firms' management.

From the perspective of policy recommendations, the first is to strengthen the construction of infrastructure, to promote the continued positive impact of digital inclusive finance on enterprise innovation, it is indispensable to ensure the construction of digital infrastructure and the development of digital technology; the second is to continue to dig deep into the potential of digital inclusive finance, give full play to its characteristics, and improve the precise docking with various enterprises, based on the full development of digital inclusive finance, how to comprehensively and effectively apply it to enterprise innovation is the most critical link; finally, as a new technology, regulation is essential, through the innovation of regulatory technology, so that credit rating mechanisms and digital inclusive finance can promote each other, thus ensuring the credit rating mechanism and the development of enterprise innovation. Based on the full development of digital inclusive finance, how to effectively apply it to enterprise innovation is the most critical link; finally, as a new type of technology, regulation is indispensable, through the innovation of regulatory technology, so that the credit rating mechanism and digital inclusive finance can promote each other, to ensure the fairness of the credit market, and to protect the rights and interests of small and medium-sized enterprises (SMEs) to financing in the field of innovation, which is emphasized in the study of Wang Gang et al. (2023).[13]

From the point of view of the enterprise itself, the main thing for the enterprise is to improve its innovation ability, whether it is management, personnel arrangements or resource utilization and other aspects, should do the best possible configuration to meet the needs of a higher level of innovation, in addition, the enterprise should always pay attention to the economic environment trends, the use of popular big data platforms, and

continue to improve the external image of the enterprise and improve the competitiveness of enterprise innovation, work mode, management program, and enterprise products, etc. should be gradually combined with the digital financial inclusion to promote the development of high quality of corporate innovation. The working mode, management program enterprise products, etc., should be gradually combined with digital financial inclusion to promote enterprise innovation and high-quality development.

Today's research on the impact of digital inclusive finance on enterprise innovation and R & D investment still has certain limitations, because this area of China's economic field is still in a period of exploration, domestic scholars collected data and explored the impact of the mechanism is not complete, and foreign scholars of the study is difficult to be combined with China's economic environment, therefore, for further research needs to be expanded and deepened in future. Therefore, further research needs to be expanded and deepened in the future.

In summary, the following research hypotheses are proposed in this paper:

*a) Hypothesis One :**Digital financial inclusion has a positive and positive impact on firms' investment in innovation and R&D.***

a) Hypothesis Two: Digital financial inclusion can positively affect firms' liquid assets by enhancing their liquidity, which in turn drives increased investment in innovative R&D.

*a) Hypothesis Three: **The impact of digital financial inclusion on firms' innovative R&D investment has a lag and is more significant with a lag.***

3.EMPIRICAL RESEARCH DESIGN

3.1 Data sources and sample selection

3.1.1 Data sources

3.1.1.1 Sample selection and data sources

The sample of this paper is selected as the original sample of all listed enterprises in China's A-share Fujian province from 2016-2021, and the financial inclusion data in this paper is referred to the Digital Financial

Inclusion Index compiled by the Digital Finance Research Center of Peking University, drawing on the existing research paradigms. The original financial data, R&D investment data, control variables data, and corporate governance data of listed companies are mainly derived from the CSMAR database, the WIND financial database, and the annual reports of listed companies, and then matched according to the place of registration of listed companies to finalize the sample of 171 listed companies, with a total of 1084 samples as observations. The total number of samples is 1084 as observations. In this paper, we collect data samples of 764 observations for the empirical study of R&D investment. Eventually, we form a panel dataset containing 534 observations. However, due to some missing data and unbalance caused by taking logarithms, the sample of data volume used for the empirical study of corporate innovation is reduced to 473.

Meanwhile, to ensure the scientificity and completeness of the sample data, this paper screens the samples as follows:

First, this study excludes firms in the dataset that have been delisted to ensure that the analysis is of firms that are currently active and have actual trading records. Companies that have been specially treated (ST) or suspended from trading (PT) during the sample period are then excluded to avoid data bias due to special circumstances. Firms with missing key variables or data anomalies are then removed to ensure that the data used for empirical analysis is complete and accurate. Finally, STATA 18.0 software is used to process the data and perform the empirical part of the analysis, utilizing its powerful statistical functions to ensure the validity and accuracy of the analysis.

Table 1 shows the individual variable codes, meanings, and sources:

Table1. Basic information of variable data

Variable type	*variable code*	*Variable Meaning*	*Source of variables*
explanatory variable	*RD*	*R&D investment*	*Listed Companies Database*
explanatory variable	*Finance Index*	*Financial inclusion index*	*Digital Finance Research Center, Peking University*
intermediary	*Liquid*	*current asset*	*CSMAR database*

variable	*Assets*		
control variable	*TA* *TL* *IA* *PP* *NP* *OR* *OC* *OP* *SIZE* *ROA* *LEV*	*total assets* *total liability* *intangible asset* *Net profit attributable to shareholders* *net profit* *revenues* *business costs* *business profit* *Enterprise size* *return on assets* *gearing*	*CSMAR database*

3.2 Variable setting and descriptive statistics

3.2.1 Variable setting

3.2.1.1 Explained Variables

Explained Variables-Enterprise R&D Investment (Research & Development, RD). This study focuses on the impact of digital financial inclusion on the R&D investment of listed companies in Fujian Province. According to the existing data on enterprise R&D investment, this paper adopts enterprise R&D investment to measure the technological innovation ability of enterprises by drawing on the relevant practice of Yu Guansheng (2023)[14]. The logarithm of the R&D investment of listed companies in Fujian Province is chosen to represent the R&D investment of listed companies in Fujian Province. The higher the RD, the more R&D investment. The higher the RD, the more the R&D investment is. In addition, the R&D investment is treated as logarithmic.

3.2.1.2 Core explanatory variables

The core explanatory variable is the Digital inclusive finance index (Fiance index), which is the main source of explanatory variables in this paper. The index consists of the total index, the depth of use, and the breadth of coverage, and the three dimensions portray the process of digital finance development in China's provincial and prefecture-level cities. The index measures the level of digital inclusive finance in China's 31 provincial-level administrations, 337 prefecture-level cities, and 2,800 counties. The higher the value of the index the higher the development level of digital finance. This paper draws on Guo Feng et al. (2020) to adopt the "Digital Inclusive Finance Index" compiled by their Digital Finance Research Center at Peking University and Ant Group Research Institute (Second Issue, 2011-2018) [15]. The digital inclusive finance development index at the city level at the prefecture-level corresponding to the city where the listed company is registered is used as an explanatory variable. To ensure the matching with the financial data of enterprises and the accuracy of the test results, all indices are taken as natural logarithms for smoothing for empirical research.

3.2.1.3 Control variables

This paper uses relevant control variables at the financial level of listed companies, this paper draws on the practice of Yu Ping and Dou Junxia's

(2020) study[16], as well as combining the object of this paper to select representative financial data of listed companies in Fujian Province. To minimize the omitted variable bias, several representative control variables are included in the regression model, including total assets, total liabilities, net profit attributable to shareholders of listed companies, net profit, operating income, operating costs, operating profit, return on assets, size level (Size), gearing ratio (Leverage). The control variables are also expressed in logarithmic terms, in addition to the two dummy variables of year and industry.

3.2.2 Descriptive statistics

Before systematically analyzing the sample data, the variables are analyzed by descriptive statistics and correlation statistics, and Table 2 demonstrates the descriptive statistics results of all the variables involved in the sample of listed companies in Fujian Province.

Table 2. Descriptive statistics for all variables

VarName	Obs	Mean	Median	Min	Max.	SD
RD	534	17.7529	17.836	12.857	22.106	1.483
Finance Index	534	5.6207	5.621	5.319	5.839	0.125
LA1	534	21.4637	21.426	14.707	27.034	1.483
IA1	534	18.5131	18.643	12.279	22.054	1.451
NP1	476	18.8708	18.849	14.035	23.118	1.457
OR1	534	21.5801	21.317	14.433	27.285	1.622
OP1	475	19.0097	18.957	15.340	23.473	1.487
SIZE1	534	3.0924	3.091	2.634	3.300	0.061
ROA1	476	-3.2019	-3.106	-6.779	4.202	1.017
TA1	534	22.0714	21.991	13.934	27.124	1.330
TL1	534	21.0781	21.080	14.027	26.866	1.671
PP1	479	18.7653	18.714	13.770	22.596	1.439
OC1	534	21.2523	20.989	16.062	27.249	1.742
LEV1	534	-0.9933	-0.825	-6.192	3.499	0.693

According to the results of the above table, it can be seen that the data is unbalanced panel data, and the effective sample number is 534. From 2016 to 2021, the minimum value of R&D investment of each listed enterprise in Fujian Province is 12.857, the maximum value is 22.106, and the mean and standard deviation are 17.75 and 1.483, respectively, with a large degree of fluctuation, indicating that the level of R&D

investment varies greatly among enterprises. The average value of the logarithm of the digital financial inclusion index is 5.62, and the difference between the minimum and maximum values is 5.32 and 5.84 respectively, indicating that there is a significant imbalance in the degree of development of digital financial inclusion among different prefectures and cities in Fujian. Meanwhile, the minimum and maximum values of corporate liquid assets are 14.707 and 27.034, respectively, with a mean value of 21.46, indicating that there is also a large gap in the level of liquidity possessed by listed enterprises among them. Regarding the control variables, the mean value of the logarithm of the return on assets of listed firms is -3.2 and the standard deviation is 1.017, with a maximum of 4.202 and a minimum of -6.779, indicating that there is a relatively large change in the return on assets of firms. In addition, regarding the variable of firm size, the logarithmic mean of total firm assets is 22.07, the minimum is 13.93, the maximum is 27.12, and the standard deviation is 1.33. This indicates that there is a large variation in the size of listed firms in Fujian Province, with some firms possessing larger-scale assets while others are smaller. All other control variables have obvious differences in the maximum and minimum values and relatively large standard deviation values, which also reflects that the sample firms have great differences in solvency and operational capacity.

Taken together, the peaks, valleys, fluctuations, and averages of each parameter were generally kept within an acceptable level, and no significant outliers were found to have a significant impact on the results, which indirectly verifies the reliability of the data and further enhances the credibility of the analytical conclusions.

It should also be added that because some of the variables are not at the same level as each other, the above data were logarithmized to solve the problem of uniformity of the scale. All the variables are also indented by 1% up and down to eliminate the disturbing effect of extreme data.

3.3 Modeling

3.3.1 Modeling

3.3.1.1Research Methodology

This study uses a panel regression model to explore the relationship between digital financial inclusion and R&D investment of listed companies in Fujian Province. Panel data combines time series and

cross-sectional data, which can effectively capture time dynamics and inter-unit changes. Therefore, this paper chooses to use STATA18 for subsequent econometric analysis to further validate the relationship.

3.3.1.2Modeling

In response to the study of the impact of digital financial inclusion on R&D investment, the Hausman test was first implemented on the selected data samples, but the test results refuted the original hypothesis, so it points to the applicability of the fixed effects model. Due to the development of listed enterprises, the industry in which they are located is related to the R&D innovation of listed enterprises, and there are different degrees of inter-individual differences. Therefore, this paper chooses to use the panel data fixed effects model.

Drawing on the research of Tang Song et al. (2020), this paper first considers that the differences at the level of the industry in which they are located and the time-varying factors of listed companies can have an impact on firms[17], and effectively test the relationship between the digital inclusion index and R&D investment (i.e., Hypothesis 1), this paper establishes model (1):

$$RD_{i,t} = \beta_0 + \beta_1 Finance\ Index_{i,t} + \sum_{j=2}^{12} \beta_j\ Controls_{i,t} + \lambda_i + \tau_t + \varepsilon_{i,t} (1)$$

where i represents each listed company in Fujian Province and t represents time (year).$RD_{i,t}$ represents the level of technology R&D investment of theithenterprise in year t;$Finance\ Index_{i,t}$ represents the level of digital financial inclusion development of theithenterprise in year t;β_0 is a constant term.β_1 withβ_j are the parameters to be estimated, and$Controls_{i,t}$ represents the control variables, and$\varepsilon_{i,t}$ represents the random error term, withλ_i are individual fixed effects, andτ_t are time fixed effects.

Core explanatory variables$Finance\ Index_{i,t}$ The coefficient of theβ_1 indicates the extent to which the PFI influences R&D investment and is known as the empowerment effect. The coefficient is significantly positive according to the prognosis. This study focuses on the coefficient of Finance Indexβ_1, if the coefficient ofβ_1> 0, it indicates that digital financial inclusion has a facilitating effect on the R&D investment of listed companies in Fujian Province; ifβ_1<0, it indicates that digital financial inclusion has a dampening effect on R&D investment of listed companies

in Fujian Province.

Second, based on the hypothesis, all else being equal. To test whether the PFI has an effect on liquid assets (i.e., Hypothesis 2), model (2) is constructed:

$$LA_{i,t} = \theta_0 + \theta_1 Finance\ Index_{i,t} + \sum_{j=2}^{12} \theta_j\ Controls_{i,t} + \lambda_i + \tau_t + \varepsilon_{i,t} (2)$$

Finally, considering that the impact of digital financial inclusion may have a certain lag, this paper draws on Shangguan Xuming and Li Jianlan (2023) to lag one period for the explanatory variables of the digital financial index, the reason for lagging key variables is to take into account, on the one hand, the endogeneity of reverse causality, i.e., the growth of the enterprise in the same period may reverse the impact of the enterprise's financing constraints and R & D investment, and at the same time, R & D investment may also reverse the impact of financing constraints and R & D investment. R&D investment may also reverse affect financing constraints[18]; on the other hand, considering that the effect of financing constraint alleviation brought by the development of digital finance on the R&D investment of enterprises has a time lag, and the effect of R&D investment on enterprise growth also has a time lag (Wang Nan et al., 2021)[19] In the regression test, while the robust standard error of the coefficients is adjusted for clustering at the firm level. Therefore, for hypothesis 3, this paper constructs model (3):

$$RD_{i,t} = \alpha_0 + \alpha_1 Finance\ Index_{i,t-1} + \sum_{j=2}^{12} \alpha_j\ Controls_{i,t} + \lambda_i + \tau_t + \varepsilon_{i,t} (3)$$

4. RESULTS OF EMPIRICAL ANALYSIS

4.1 Correlation analysis and multicollinearity tests

Table 3. Table of variable correlation results

	RD	Finance Index	LA	IA	NP	OR	OP
RD	1						
Finance Index	0.0490***	1					
LA	0.0130	0.121***	1				
IA	0.205***	0.120***	0.198***	1			
NP	0.295***	0.0470	0.722***	0.284***	1		
OR	-0.0240	0.162***	0.848***	0.297***	0.652***	1	
OP	0.149***	0.0640	0.792***	0.284***	0.956***	0.710***	1
SIZE	0.286***	0.176***	0.475***	0.489***	0.482***	0.522***	0.519***
ROA	0.0690	-0.0560	-0.0110	-0.0270	0.0330	-0.0130	-0.0030
LEV	-0.00800	-0.0430	0.0230	0.181***	-0.0110	0.0270	0
SIZE	ROA	LEV					
SIZE	1						
ROA	-0.277***	1					
LEV	-0.155***	0.0690	1				

To accurately test the correlation between the variables to carry out the initial screening, this paper carries out the correlation test. The test results shown in Table 3, the absolute value of the correlation coefficient between the variables is generally lower than 0.8, a result that ensures the reasonableness and effectiveness of the overall fit of the subsequent model. From the table, it can be found that the correlation coefficient between the R&D investment of the sample enterprise and the enterprise's size, current assets, net profit, and operating profit is significantly positive, that is, there is a positive relationship between them, which is consistent with reality. The correlation between the other variables is not much different from the correlation statistics of existing related studies.

As can be seen from Table 3, the correlation coefficient between the digital financial inclusion development index (FinanceIndex) and corporate research and development investment (RD) was determined to be 0.049, a figure that reflects some degree of correlation between the two, with a statistically significant level of 1%. It shows the positive and positive effect that digital inclusion has on R&D investment. The

correlation coefficient of Intangible Assets (IA) is 0.205 and is significant at a 1% level, indicating that Intangible Assets can promote a significant positive effect on the R&D investment of the firms. According to Table 3, there is a negative correlation between the gearing ratio (LEV) and the R&D investment of enterprises, which reflects that enterprises with higher levels of debt are relatively less active in R&D activities. On the contrary, firm size (Size) is also positively correlated with R&D investment, with a correlation coefficient of 0.286, which is significant at the 1% significance level. This suggests that as the size of the firm increases, its enthusiasm for R&D investment increases.

Table 4. Multiple covariance test

Variable	*VIF*	*1/VIF*
OR	*3.93*	*0.254300*
LA	*3.68*	*0.271742*
SIZE	*2.09*	*0.477409*
IA	*1.51*	*0.662686*
LEV	*1.15*	*0.871580*
ROA	*1.13*	*0.882962*
Finance Index	*1.04*	*0.957903*
Mean VIF	*2.08*	

In addition, this paper, order to benchmark the accuracy and stability of the regression, this paper also before the regression analysis. A multiple covariance analysis test was carried out, which is mainly measured using the variance inflation factor (VIF), generally when the VIF is between 0 and 10 there is no strict covariance relationship between the independent variables. As shown in Table 4 of this paper, the maximum value of VIF in the variables is 3.93, which does not exceed the commonly set threshold of 10. Accordingly, this paper considers that the selection of model variables is more reasonable, and therefore, it can be assumed that there is no problem of multicollinearity among the variables. Empirical analysis can be carried out.

4.2 Analysis of baseline regression results

For the panel data used in this paper, it is often necessary to consider whether a fixed effects model or a random effects model should be used when performing regression analysis. Therefore, the Hausman test is first utilized to determine the more appropriate regression model, as the results of both the F-test and the Hausman test exhibit statistical significance at the 1% significance level. Therefore, the original hypothesis of choosing mixed and random effects models was rejected in

this paper in favor of using a fixed effects model for the regression analysis.

Table 5 demonstrates the results of the impact test of the digital inclusion index on the R&D investment of listed firms. In the regression model, this paper uses firm clustering effects to correct for standard errors and controls for individual firms and year-fixed effects. After introducing firm and city-level control variables, the paper conducts the following analysis. In the regression results of model (1), the regression coefficient of the digital financial inclusion index on R&D investment of listed enterprises is 0.898, also at a 1% significant level, which proves that digital financial inclusion can significantly promote the growth of R&D investment of listed enterprises, and controlling for other variables, a 1% change in the digital financial inclusion index changes, on average, the R&D investment changes by 0.898% in the same direction. Therefore, digital financial inclusion has a significant positive effect on the increase of R&D investment of listed firms in Fujian Province, which is consistent with the expectation of this paper, and Hypothesis 1 is verified. In column (2) of the model, the coefficients of IA and np are significantly positive at the 1% significance level, which is 0.124 and 2.111, respectively, indicating that the increase in both intangible assets and net profit of listed enterprises significantly promotes the level of R&D investment of enterprises. The size regression coefficient is -29.63, enterprise size is significantly negatively correlated with enterprise R&D investment at a 1% level. This indicates that the expansion of enterprise size makes the enterprise's investment in R&D decline.

In column (2) of the model, in the location of listed enterprises, the digital financial inclusion index and the number of liquid assets of enterprises reached a significant positive correlation of 1%, and every 1% increase in the digital financial inclusion index will make the liquid assets of enterprises increase by 4.695% relative to their average value, the test results show that the regional development of digital financial inclusion has a substantial positive effect on the liquidity of enterprises. Thus, hypothesis 2: digital inclusive finance can positively affect corporate liquidity by enhancing corporate liquidity, thus promoting the increase of corporate innovation and R&D investment in the hypothesis has been verified. Thus, both hypotheses 1, and 2 and the model of this paper are verified in phase, i.e., as shown in Figure 1.

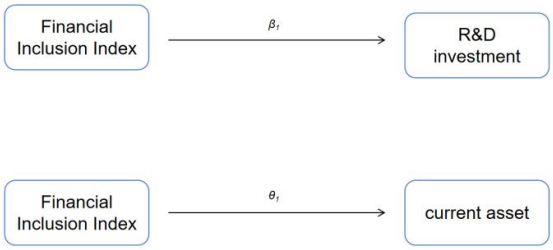

Fig. 1 Positive effect of PFI on liquid assets as well as R&D investment

In addition, it is found through a large amount of other related existing literature that mediating variables like current assets can promote the enhancement of R&D investment. Then again, combined with Jiang Boat (2022) mediation effect research analysis[20] and Wen Zhonglin et al. (2004)[21], Wen Zhonglin et al. (2005)[22], Wen Zhonglin and Ye Baojuan (2014) and other causal inference empirical studies of the impact of[23] so that can be explained through the mediation effect of the way: the financial inclusion index positively affects the liquidity of the current assets, and thus through the liquidity of the current assets as a mediator variable impact on the enhancement of R & D inputs, that is, Figure 2 shows:

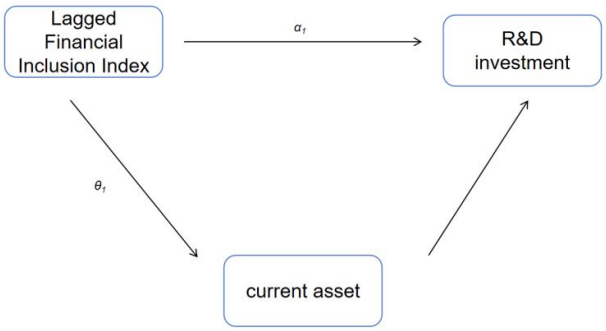

Fig. 2 Positive effect of PFI on current assets as well as R&D investment

Table2. Benchmark regression results

variant	*(1)*	*(2)*
	RD	*la1*
Finance	*0.8980****	*4.6952****
Index	*(3.29)*	*(3.73)*
IA1	*0.1239****	*-0.0808*

	(2.61)	*(-1.49)*
NP1	*2.1111****	*3.1466****
	(3.77)	*(4.92)*
OR1	*-0.0940*	*0.1446**
	(-1.32)	*(1.77)*
OP1	*-0.2650****	*-0.2511****
	(-4.37)	*(-3.62)*
SIZE1	*-29.6300****	*-42.8517****
	(-2.96)	*(-3.75)*
ROA1	*-1.7449****	*-2.8081****
	(-3.17)	*(-4.46)*
LEV1	*0.0283*	*0.0085*
	(0.38)	*(0.10)*
constant term (math.)	*63.6778***	*63.2913**
	(2.11)	*(1.83)*
Year fixed effects	*containment*	*containment*
firm fixed effect	*containment*	*containment*
N	*473.0000*	*473.0000*
Adjusted R^2	*0.3481*	*0.4855*

*Note: t-values in parentheses, * indicates p < 0.1, ** indicates p < 0.05, *** indicates p < 0.01.*

4.3 Robustness tests

The logarithm of firms' R&D investment is used to denote listed firms' R&D investment in the benchmark regression, and it is found that the Digital Inclusion Index has a significant positive and positive effect on firms' R&D investment.

Robustness testing is crucial for the reliability of research findings. To test the robustness of the model, two methods were used in this paper to test the robustness of the model to ensure the robustness and credibility of the research findings. The commonly used method is to change the sample time horizon.

Firstly, the sample time horizon is changed to take into account the impact of the global new crown epidemic in 2020, which may result in the later data not being somewhat comparable with the previous data. The regression analysis is re-run using the sample of listed firms in Fujian Province from 2016-2020 brought into the model (1). This is done to test whether the model results are affected by the time horizon to confirm the robustness of the findings. The regression results can be seen in column (1) of Table 6 below, where the coefficient of the Digital Financial Inclusion Index is 0.26 and passes the test at the 1% significance level. This indicates that the Digital Inclusion Index still has a significant impact on the R&D investment of listed firms and the direction of the regression coefficient remains consistent with the results of the original model, but the size of the coefficient has been reduced.

4.4 Lag analysis

It may take some time for the development of digital financial inclusion to have an impact on firms, thus promoting their R&D investment. At the same time, the enhancement of firms' R&D investment may also contribute to the digital financial inclusion index. The impact of R&D investment on enterprise growth also has a certain time lag. In this paper, we replace the explanatory variable Digital Inclusion Index with one period of lagged data and re-estimate the model. The results of model (3) in column (2) of Table 6 show that the coefficient of the Digital Inclusion Index with a one-year lag is 1.178 and passes the 1% significance test. Even after changing the choice of explanatory variables, the regression results of the model are still consistent with the previous ones, and the positive impact of digital financial inclusion on the R&D investment of enterprises is still significant, which strengthens the reliability of the conclusions of this study, indicating that the conclusions are not affected by the choice of explanatory variables and the results imply that the development trend of the level of development of digital financial inclusion in the region is persistent. In addition, the regression results of the control variables are also consistent with the previous

section. Therefore, Hypothesis 3 is verified, i.e., the impact of digital inclusive finance on enterprises' innovative R&D investment has a certain lag, and the impact is more significant with a lag.

Table 6. Robustness test and lag analysis

Variables	*(1)*	*Models (3)*
	RD (2016-2020) Reduced range robustness	*RD*
Financial inclusion index	*0.2629****	
	(5.07)	
Lagged Financial Inclusion Index		*1.1784****
		(4.52)
LA1	*0.1875****	*-0.0613*
	(2.22)	*(-1.11)*
NP1	*1.5159**	*0.5304*
	(1.38)	*(0.41)*
OR1	*-0.1066*	*0.2926***
	(-0.62)	*(2.36)*
OP1	*-0.2517****	*-0.1298**
	(-1.46)	*(-1.78)*
SIZE1	*-19.1239*	*-0.3913*
	(-0.96)	*(-0.01)*
ROA1	*-1.0752*	*-0.4709*
	(-0.99)	*(-0.37)*
LEV1	*-0.0562*	*0.3161****
	(-0.43)	*(3.06)*
constant term (math.)	*46.7291*	*-1.4002*
	(0.87)	*(-0.02)*
Year fixed effects	*containment*	*containment*
firm fixed effect	*containment*	*containment*
N	*320.0000*	*389.0000*
Adjusted R^2	*0.3236*	*0.3911*

*Note: t-values in parentheses, * indicates p < 0.1, ** indicates p < 0.05, *** indicates p < 0.01.*

4.5 Heterogeneity analysis

Because of the differences between different listed enterprises due to the nature of ownership, asset size, profitability, and local marketization level, it may lead to different degrees of impact of the level of digital financial inclusion on their R&D investment. Therefore, the impact of digital financial inclusion level on their R&D investment among different types of enterprises is explored in depth, and the enterprise samples are divided into two categories of state-owned and non-state-owned enterprises, regrouped and regressed, and the regression results are shown in Table

1. The digital financial inclusion index has a significant positive effect on state-owned enterprises, and it passes the 1% significance level test. It is observed that the regression coefficient of the digital financial inclusion index on R&D investment is 4.0312 in the sample of state-owned enterprises and is significant at a 1% significance level. Further than that, it can be seen that for every 1% increase in the digital financial index, the R&D investment of SOEs increases by 4.03%, while the corresponding increase in R&D investment of SOEs is -2.1%, which indicates that the empowering effect of digital finance on SOEs is stronger.

The results show that the development of digital inclusive finance can significantly promote the R&D investment of state-owned enterprises and boost their innovation capacity. It indicates that the government has taken active policy measures in the development of digital inclusive finance, which provides state-owned enterprises with more financing support and innovation resources. The difference is that the effect of the digital financial inclusion index on R&D investment is not significant in the sample of non-state-owned enterprises. The effects of other control variables on R&D investment are consistent with the previous section. The test results reflect the differences between SOEs and non-SOEs in terms of business nature, financing channels, and decision-making mechanisms. State-owned enterprises are more influenced by policy support and resource advantages, and the progress of digital inclusive finance has an obvious positive impact on their R&D expenditures. Non-state-owned enterprises, on the other hand, focus more on market competition and benefit maximization and rely less on digital financial inclusion, so their R&D investment is not significantly affected by the development of digital financial inclusion.

Table 7. Heterogeneity test

	(1)	*(2)*	
	state enterprise	*non-state enterprise*	
Finance Index	*4.0312****	*-2.0987*	
	(4.92)	*(0.59)*	
IA1	*0.1536***	*0.1272***	
	(2.49)	*(2.48)*	
NP1	*2.1269****	*2.1909****	
	(2.99)	*(3.02)*	
OR1	*-0.2449****	*-0.1251*	
	(-2.61)	*(-1.54)*	
OP1	*-0.4147****	*-0.2988****	

	(-5.32)	*(-3.83)*	
SIZE1	*-24.4765**	*-30.5989***	
	(-1.95)	*(-2.41)*	
ROA1	*-1.5781***	*-1.7467***	
	(-2.26)	*(-2.47)*	
LEV1	*0.1087*	*0.0107*	
	(1.04)	*(0.12)*	
constant term (math.)	*36.3486*	*82.8051***	
	(0.89)	*(2.21)*	
time fixed effect	*containment*	*containment*	
individual fixed effect	*containment*	*containment*	
sample size	*276*	*258*	
R^2	*0.4058*	*0.4355*	

*Note: t-values in parentheses, * indicates p < 0.1, ** indicates p < 0.05, *** indicates p < 0.01.*

5. CONCLUSIONS AND RECOMMENDATIONS OF THE STUDY

5.1 Conclusions of the study

Based on the financial data of 171 listed companies in Fujian Province from 2016 to 2021 and the digital financial inclusion index of related regions, this paper constructs a theoretical model to test the role of the digital financial inclusion index on the R&D investment of enterprises based on borrowing and innovating the existing theories and methods. This study aims to investigate the impact of digital financial inclusion on enterprise R&D investment and analyzes the mediating role of enterprise liquid assets in this process. The results show that digital inclusive finance has a significant impact on corporate R&D investment, in which corporate liquid assets play a partially mediating role between digital inclusive finance and corporate R&D investment, and the impact of digital inclusive finance on corporate innovative R&D investment has a certain lag. In addition, through the heterogeneity analysis, it is found that the development of digital inclusive finance can significantly promote the R&D investment of state-owned enterprises, and promote the enhancement of enterprise innovation ability. To ensure the credibility of the research results, this paper adopts a panel data fixed-effects model to examine the relationship between the level of digital financial inclusion and enterprises' R&D investment and considers the potential endogeneity problem.

To this end, this study presents the following conclusions:

1. After conducting correlation analysis as well as the VIF test to eliminate the serious linear correlation between different variables in the model, regression analysis through the fixed-effects model reveals that digital inclusive finance has a positive and positive impact on R&D investment in enterprise innovation, and Hypothesis 1 is verified. This positive association provides empirical support for the key role of digital inclusive finance in promoting enterprise innovation.

2. Through the data analysis of the model (2), it is found that the digital financial inclusion index has reached a significant positive correlation of 1% with the number of liquid assets of enterprises, which indicates that digital financial inclusion can positively affect the liquid assets of enterprises by enhancing their liquidity, thus promoting the increase of enterprises' investment in innovative R&D and that Hypothesis 2 is established. After the robustness test, the positive effect of digital financial inclusion on corporate R&D investment remains obvious.

3. This study replaces the explanatory variable digital financial inclusion index with the data of the lagged period and re-estimates the model for regression analysis, the data show that the impact of digital financial inclusion on the enterprise's innovation and R&D investment has a certain degree of lagging, and the impact is more significant in the lagged situation, and Hypothesis 3 is verified.

4. After analyzing the heterogeneity of enterprises, this paper finds that the development of digital inclusive finance can significantly promote the R&D investment of state-owned enterprises and promote the enhancement of their innovation ability. The development of digital inclusive finance can greatly improve the R&D investment of China's state-owned enterprises, which in turn improves their independent innovation ability. However, non-state-owned enterprises are more concerned about market competition and profit maximization, the dependence on digital inclusive finance is not strong, and the development of digital inclusive finance is not obvious to their R&D investment.

5.2 Policy recommendations

Based on the results of the aforementioned research, to further promote the in-depth development of digital inclusive finance, enhance the

investment of enterprises in R&D, promote technological progress, and realize the strategic goal of scientific and technological power, this study puts forward the following recommendations:

First, between industry-specific impacts, regional differences, and firm size, governments should deeply analyze the differences in the impact of digital inclusion on R&D investment in different industries, and understand the impact on R&D investment of firms in different regions as affected by Digital Inclusion Index, to reveal the inequality of digital infrastructure and access to finance, and to lead to recommendations for targeted policy interventions to optimize the experience of startups or SMEs.

Secondly, the Government should alleviate the R&D costs of enterprises and stimulate innovation in the field of digital inclusive finance through the establishment of special funds, the provision of tax incentives and low-interest loans, and other measures. At the same time, it should strengthen cooperation between enterprises and research institutions through talent training programs and the construction of technological innovation platforms to promote the cultivation of professionals and the iterative updating of technology.

Third, the government needs to optimize the market environment, establish a sound system of relevant laws and regulations, protect the rights and interests of enterprises and consumers, and improve the fairness of market competition. Through the establishment of a digital inclusive finance information platform, information asymmetry can be reduced and service efficiency can be improved. At the same time, the regulatory system for digital inclusive finance should be strengthened, unified regulatory norms should be formulated, and inter-regional differences in inclusive finance regulation should be eliminated within the scope of regionalization.

REFERENCES

[5]

1. *CHI Lihua, SHI Wanju. The driving effect of digital inclusive finance on firm performance - the mediating role of financing constraints and R&D investment[J]. Technology and Innovation Management,2023,44(05):552-563.DOI:10.14090/j.cnki.jscx.2023.0505.*
2. *DUARTE J, SIEGEL S, YOUNG L. Trust, and credit: The role of appearance in peer-to-peer lending[J].Review of Financial Studies, 2012(25):2455-2483.*
3. *Lai Li-Qi, Huang Tuo-Ting. Digital Inclusive Finance, RD Input and Firm Innovation[J]. Technology Entrepreneurship Monthly,2023,36(03):116-123.*
4. *Zeng Yating,XingJingjing,Li Bin. Impact of digital finance development on the growth of start-ups - Chain mediation effect and heterogeneity analysis of financing constraints and R&D investment[J]. Western Forum,2022,32(06):20-36*
5. *FIORENTINO R, LONGOBARDI S, SCALETTI A. The early growth of start-ups: innovation matters: evidence from Italy [J]. European Journal of Innovation Management, 2020, 24(5):1525-1546.*
6. *Guo Mengyuan. Research on the impact of digital inclusive finance on enterprise innovation[J]. National Circulation Economy,2023,(23):153-156.DOI:10.16834/j.cnki.issn1009-5292.2023.23.003.*
7. *Hu Bing, Qi Yudong. Digital Finance and Enterprise Technology Innovation: Is Self-Media a "Stimulant" or a "Sedative"? [J]. Financial Review,2023,15(04):44-69+124-125.*
8. *Xie, Gloria, Shen, Yan, Zhang, Haoxing, et al. Can Digital Finance Promote Entrepreneurship? --Evidence from China[J]. Economics (Quarterly),2018,17(04):1557-1580.DOI:10.13821/j.cnki.ceq.2018.03.12.*
9. *BECK T A, DEMIRGÜÇ K, MAKSIMOVIC V. Financial and legal constraints to growth: does firm size matter?[J]. the journal of finance, 2005, 60(01):137 The journal of finance, 2005, 60(01):137-177.*
10. *Wang P, Wang K. Digital Finance and Corporate Innovation Output - Moderating Effects Based on Reverse Mixing in Privately Listed Companies[J]. Finance and Accounting Monthly,2022,(17):114-121.DOI:10.19641/j.cnki.42-1290/f.2022.17.015.*
11. *Spulber D F. How do Competitive Pressures Affect Incentives to Innovate when there is a Market for Inventions?[J]. Journal of Political Economy,2013,121 (6):1007-1054.*
12. *PAN Yaru, WEI Jing. Digital inclusive finance and high-quality economic development: theoretical mechanisms, empirical evidence, and policy options[J]. Western Economic Management Forum,2023,34(02):1-18.*

13. *Wang Gang, Chen Di. Digital financial inclusion and technological innovation of small and medium-sized enterprises[J]. Statistics and Decision Making,2023,39(19):177-182.DOI:10.13546/j.cnki.tjyjc.2023.19.033.*
14. *Yu, Guansheng. Digital Finance Development, Corporate R&D Investment and Innovation - An Empirical Study Based on a Sample of Listed Companies[J/OL]. Economic Journal,1-28[2024-04-05].https://doi.org/10.16513/j.cnki.cje.20230424.001.*
15. *GUO Feng,WANG Jingyi,WANG Fang,et al. Measuring the development of digital inclusive finance in China: indexing and spatial characterization[J]. Economics(Quarterly),2020,19(04):1401-1418.DOI:10.13821/j.cnki.ceq.2020.03.12.*
16. *YU Ping, DU Junxia. Digital Inclusive Finance, Enterprise Heterogeneity and Innovation of Micro, Small and Medium Enterprises[J]. Contemporary Economic Management,2020,42(12):79-87.DOI:10.13253/j.cnki.ddjjgl.2020.12.011,*
17. *TANG Song,WU Xuchuan,ZHU Jia. Digital finance and corporate technological innovation - structural characteristics, mechanism identification and effect differences under financial regulation[J]. Management World,2020,36(5)*
18. *Shangguan Xuming,LiJianlan. Research on the Impact of Digital Finance on Enterprises' Science and Technology Innovation--Micro Evidence Based on the Perspective of Credit Financing Constraints[J]. Journal of Xinyang Normal College (Philosophy and Social Science Edition),2023,43(01):21-27.*
19. *WANG Nan,ZHAOYi,CONGJikun,et al. Research on the double threshold effect of R&D investment on firm growth in science and technology start-ups[J]. Science and Technology Management Research,2021,41(11):131-138.*
20. *Jiang Boat. Mediating and moderating effects in empirical studies of causal inference[J]. China Industrial Economy,2022,(05):100-120.DOI:10.19581/j.cnki.ciejournal.2022.05.005.*
21. *WEN Zhonglin. ZHANG Lei, HOU Jetai, et al. The mediation effect test program and its application[J]. Journal of Psychology,2004(05):614-620.*
22. *WEN Zhonglin, HOU Jietai, ZHANG Lei. Comparison and application of moderating and mediating effects[J]. Journal of Psychology,2005(02):268-274.*
23. *WEN Zhonglin, YE Baojuan. Mediation effects analysis: Methods and model development[J]. Advances in Psychological Science, 2014,*

22(05):731-745.