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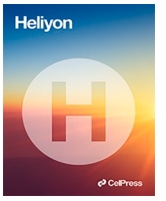

Research article

How does digital inclusive finance influence non-agricultural employment among the rural labor force? ——Evidence from micro-data in China

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ABSTRACT

In the context of the integration and development of inclusive finance and digital technology, exploring the relationship between digital inclusive finance and non-farm employment of rural laborers is of great significance in promoting rural economic development and realizing common prosperity for all. Based on data from the 2018 and 2020 China Family Tracking Survey (CFPS) and Peking University's Digital Financial Inclusion Index, this paper investigates the impact of digital inclusive finance on the non-farm employment of rural labor and its transmission mechanism. The results of the study show that both digital inclusive finance and its sub-dimensions can promote the non-farm employment of rural laborers, and have stronger inclusion and inclusiveness compared with traditional inclusive finance. Mechanism analysis shows that both Internet use and social trust can positively moderate the relationship between digital inclusive finance and non-farm employment of rural laborers, and that digital inclusive finance can promote non-farm employment of rural laborers by alleviating financing constraints and enhancing risk preferences. Further heterogeneity analysis shows that digital inclusive finance promotes employed non-farm employment more significantly than entrepreneurial non-farm employment, and on this basis, there are also differences for different employment groups and different regions. The findings of this study aim to provide theoretical reference and support for relevant departments to formulate policies to realize higher quality full employment of rural labor.

1. Introduction

The report to the 20th National Congress of the Communist Party of China underscored the importance of "promoting integrated urban-rural development and facilitating the exchange of resources between urban and rural areas" as well as "expanding opportunities for farmers to increase their income and achieve prosperity." In December 2023, the Central Government stressed the country's commitment to "effectively addressing agricultural, rural, and farmer-related issues and implementing measures to boost farmers' income" during the Rural Work Conference. It is recognized that a stable employment environment and access to high-quality employment opportunities in rural areas are essential for raising farmers' income levels and realizing shared prosperity. In rural areas where information and resources are relatively limited, non-agricultural employment income has become the primary driver of

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income growth for farmers. As China's urbanization continues to progress, the labor market is expanding. This has led to a significant migration of rural laborers to urban areas or other non-agricultural regions, facilitating the transition from agricultural to non-agricultural employment [1]. The "Survey Report on Migrant Workers"[1] released by the National Bureau of Statistics, as shown in Fig. 1, indicates that except for the impact of the epidemic in 2020, the scale of migrant workers has steadily increased in other years. By the end of 2022, the total number of migrant workers nationwide reached 300 million, an increase of 3.11 million compared to the previous year, registering a growth rate of 1.1 %. Moreover, considering the proportion of the rural labor force engaged in non-agricultural employment, it is anticipated that the transition of rural labor to the non-agricultural sector will continue for some time. However, the sustained impact of the COVID-19 pandemic over the past three years and the volatile international situation have posed severe crises and challenges to the global economy [2]. As the world's largest developing economy, China's labor market, especially the rural labor market, is significantly affected [3]. Given China's unique dual economic structure and the imbalance between urban and rural labor supply and demand, it turns out that simply examining rural labor employment in terms of total quantity is insufficient to meet current needs.

In recent years, the digital economy has permeated various aspects of social life, greatly enhancing the efficiency of economic and social operations. It has emerged as a new engine driving China's economic development and transformation. According to data from the China Academy of Information and Communications Technology,[2] the value added by China's digital economy has surged from 260 million yuan in 2005 to 50.2 trillion yuan in 2022, accounting for approximately 41.5 % of the gross domestic product (GDP). With the penetration of the digital economy and the advancement of inclusive finance, researchers have begun assessing the economic impacts of digital inclusive finance development. Their findings reveal that digital inclusive finance plays a pivotal role in narrowing income disparities [4], expanding residents' consumption capabilities [5], reducing urban carbon emissions intensity [6], and fostering inclusive economic growth [7]. Subsequently, many scholars have shifted their focus towards exploring the impact of digital inclusive finance on household economic behavior. Their research can be broadly categorized into the following four themes: Firstly, in terms of household wealth, digital inclusive finance enhances household economic opportunities (entrepreneurship and financial markets), while also effectively mitigating household financial vulnerability [8]. The widespread adoption of digital technology can increase the overall wealth of households through the appreciation of durable consumer goods, financial assets, and real estate, with a more pronounced influence on rural households [9]; Secondly, concerning household income, digital inclusive finance can facilitate non-agricultural labor-intensive employment, effectively reducing the degree of income inequality between households. Particularly, wage income plays a major role in increasing income growth for rural householders [10–13]; Thirdly, the discussion revolves around household consumption, which emphasizes the non-linear impact of digital inclusive finance optimizing household consumption structures. This effect is pronounced especially in rural areas, as well as in the central and western regions of China, and among middle-to-low-income households [14,15]. Leveraging digital technology, households can enhance their capacity to manage consumption risks through social networks and self-insurance mechanisms [16]; Fourthly, attention is directed towards family entrepreneurship. Studies suggest that digital inclusive finance is instrumental in improving the quality of employment by promoting regional innovation, supporting entrepreneurial endeavors, and accelerating industrial restructuring [17,18]. Consequently, this fosters the growth of family-run farms, farmer cooperatives, and agricultural enterprises in rural areas, providing substantial benefits to families with constrained material or social assets while encouraging entrepreneurial initiatives [19,20]. Furthermore, research on the impact of digital inclusive finance on residents' employment highlights its crucial role in bringing job opportunities for residents. Specifically, the main effect is seen in the expansion of non-agricultural employment and the employment scale in private enterprises [21]. Additionally, other studies have shown that digital inclusive finance substantially raises the employment rate in household sectors, and its development further promotes residents' employment by stimulating the increase of entrepreneurship and self-employment activities [22].

The aforementioned research provides valuable insights for this paper, yet it also presents some gaps. Firstly, existing research on the impact of digital inclusive finance on household economic behavior primarily focuses on aspects such as family wealth, income, and consumption. However, limited attention has been paid to the influence of digital inclusive finance on residents' employment, especially concerning rural laborers, a vulnerable group that remains underexplored in terms of their employment dynamics. This necessitates further investigation into its actual effectiveness. Secondly, while existing studies emphasize the impact of the development of digital inclusive finance driven by digital technology on rural labor force employment, they inadequately explore other potential pathways of influence. For instance, digital inclusive finance may positively contribute to non-farm employment for rural laborers by alleviating financing constraints, enhancing risk preferences, and other strategies. Therefore, there is a need for further clarification and refinement of its transmission mechanism. Lastly, most scholars, when examining the impact of digital inclusive finance on household economic behavior, mainly discuss its promotion of non-farm employment from an entrepreneurial perspective. Their research unveils that digital inclusive finance positively impacts entrepreneurial non-farm employment. However, given the discrepancies in household capital endowment, many rural households favor employed non-farm employment [23], a major preference among rural youth [24]. Few studies in the existing literature have analyzed both employed and entrepreneurial non-farm employment. Additionally, with the rapid development of digital finance supported by digital technology and its deep integration with inclusive finance, new opportunities for rural labor employment have emerged. Nonetheless, the absence of comparative research with traditional inclusive finance hinders the further integration of digital inclusive finance and traditional finance. This impedes the

[1] Data Source: "Survey Report on Migrant Workers" from 2014 to 2022 (https://www.stats.gov.cn/sj/zxfb/202302/t20230203_1901452.html).
[2] Date Source: Official website of China Academy of Information and Communications Technology (http://www.caict.ac.cn/kxyj/qwfb/bps/202207/t20220708_405627.htm).

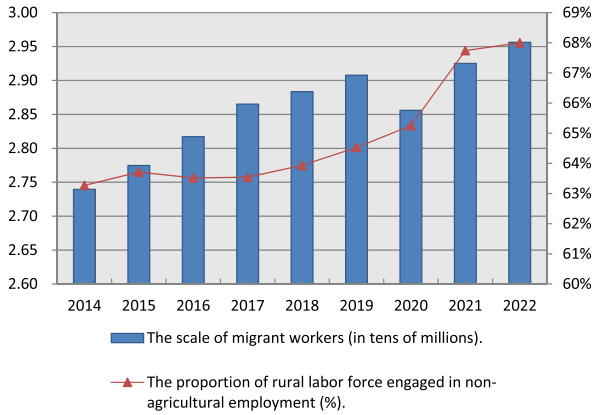

Fig. 1. Scale of migrant workers and proportion of rural labor force engaged in non-agricultural employment.
Note: Data sourced from the "Survey Report on Migrant Workers," the "China Statistical Yearbook," and the "China Rural Statistical Yearbook" from 2014 to 2022.

establishment of a complementary and mutual aid financial service system.

Digital inclusive finance, with its inherent advantages, allows the rural labor force in the long tail market of traditional financial institutions to access equal and affordable financial services. Studying the impact of digital inclusive finance on rural labor force employment, especially non-agricultural employment, holds great significance for increasing rural household income and achieving inclusive economic development in rural areas. To address the limitations of existing research, this paper empirically analyzes whether digital inclusive finance can promote rural labor force non-agricultural employment utilizing data from the CFPS database for 2018 and 2020, along with the Peking University Digital Inclusive Finance Index. If so, it seeks to identify the mechanisms or pathways through which digital inclusive finance influences employment and their differences. The potential contributions of this paper are as follows: Firstly, it attempts to construct a theoretical analytical framework, focusing on internet usage and social trust, to dissect the mechanism of digital inclusive finance's impact on non-farm employment. Meanwhile, by considering both the financing constraint effect and the risk preference effect as two transmission mechanisms, this study aims to address the deficiencies in theoretical research on rural non-farm employment concerning digital inclusive finance. Secondly, existing studies typically examine the factors influencing non-farm employment in isolation, separately focusing on traditional financial support and digital financial support. In contrast, this study recognizes the complementarity between traditional finance and digital finance and further compares the differences between the impact of digital inclusive finance and traditional inclusive finance on non-farm employment. This comparison may aid government departments in formulating targeted policies for promoting inclusive finance. Thirdly, this paper divides non-farm employment into employed and entrepreneurial employment. It further explores the impact on non-farm employment from the perspectives of individual characteristics (gender, age) and regional differences. This overcomes the limitation in previous research that only includes non-farm employment in the analysis framework. Fourthly, utilizing nationwide large-scale rural household tracking survey data, the study explores the impact of digital inclusive finance on rural labor force non-farm employment from a micro-level perspective. This further enriches the research on the macro-level aspects of digital inclusive finance and rural non-farm employment.

2. Theoretical analysis and research hypotheses

Digital inclusive finance is a new business model supported by the internet and information communication technology, which completes a series of financial activities such as third-party payment, online lending, and online insurance [25]. Relevant studies have shown that digital inclusive finance not only improves social production efficiency and reduces information asymmetry but also brings about a series of new industries, formats, and models driven by digitalization, providing new opportunities for the labor market [26]. Specifically, it offers numerous new employment opportunities for rural labor, manifested in flexible job positions such as live-streaming sales, online sales, and ride-hailing services. Digital inclusive finance mainly includes three aspects: the breadth of digital financial coverage, the depth of digital financial usage, and the level of digitization of inclusive finance. Among them, the breadth of digital financial coverage refers to the provision of sufficient digital financial services, breaking the geographical barriers and including more remote rural areas in the scope of financial services, thereby providing more financial support to rural communities in terms of production and livelihoods, and offering them diverse opportunities for non-agricultural employment development [27]. The depth of digital financial usage reflects the effective demand for digital financial services, easing the financing constraints and reducing the financing costs of numerous small and medium-sized enterprises, which helps these enterprises achieve scale and quantity expansion, thereby increasing the demand for labor [28]. The level of digitization of inclusive finance is demonstrated by the convenience, low cost, and creditization of financial services. It provides a range of financial services through financial platforms, such as online application review, loans, and repayments, reducing the time and transaction costs associated with the financing process [29], thereby assisting rural labor in meeting the startup capital requirements for employment or entrepreneurship. Based on the above

analysis, this paper proposes the following research hypothesis:

H1. The development of digital inclusive finance can promote non-agricultural employment of rural labor, and its breadth of coverage, depth of usage, and level of digitization can effectively promote non-agricultural employment.

Traditional inclusive finance is a business model dominated by traditional banking financial institutions and provided through institutional branches, which has certain geographical limitations and information asymmetry issues, leading to high operating costs. Rural residents, as an important segment of the long tail population, find it difficult to afford the necessary costs to access financial products and services. Additionally, the existence of financial exclusion in rural areas prevents them from fully benefiting from the financial services provided by traditional inclusive finance, thus hindering rural labor from obtaining the necessary funding conditions for stable entrepreneurship or employment. Compared to traditional inclusive finance, digital inclusive finance has inherent advantages in expanding the scope of financial services, controlling the cost of financial service products, and enhancing customer risk control capabilities. It can effectively alleviate the problems of long tail demand and high financial service costs in the financial market. With the development of the Internet and the widespread use of mobile devices, digital inclusive finance, relying on digital technology, makes it possible to bridge the "last mile" of financial services [30]. By leveraging Internet technology, digital inclusive finance can extend financial services to remote rural areas, providing financial services to rural labor. Meanwhile, digital technology enables rapid information transmission, effectively expanding the employment information network of rural labor, thereby broadening employment channels and increasing the probability of non-agricultural employment. Therefore, digital inclusive finance can overcome the problems of information asymmetry and high financing costs in traditional inclusive finance, facilitating rural labor to achieve non-agricultural employment. Based on the above analysis, this paper proposes the following research hypothesis:

H2. Compared to traditional inclusive finance, digital inclusive finance has a more pronounced effect on promoting non-agricultural employment of rural labor.

The Internet, as an effective medium for information exchange, also serves as a crucial platform for the implementation of digital inclusive finance. According to the 52nd Statistical Report on the Development of China's Internet issued by the China Internet Network Information Center (CNNIC),[3] as of June 2023, the number of Chinese Internet users has increased from 731 million in 2016 to 1.079 billion, with rural Internet users reaching 301 million, accounting for 27.9 % of the total Internet users. The improvement in Internet penetration rates provides a more convenient and cost-effective channel for labor to enhance their human and social capital, offering new opportunities and possibilities for non-agricultural employment in rural areas [31]. On one hand, the development of the Internet facilitates the dissemination and spillover effects of knowledge, granting social disadvantaged groups, including rural residents, the opportunity to acquire professional knowledge and digital skills. This promotes the accumulation of human capital among socially disadvantaged groups, thereby alleviating the constraints on non-agricultural employment choices posed by insufficient educational backgrounds [32]. On the other hand, digital inclusive finance, propelled by the widespread application of the Internet and mobile communication, has seen significant development. The rapid transmission of information enables convenient communication between individuals, effectively expanding the social capital of labor. Rural labor can utilize online job hunting and expand personal networks to access more employment opportunities. Moreover, the rapid advancement of Internet technology facilitates the swift matching of labor market supply and demand, optimizing resource allocation efficiency, thereby reducing the information search costs in the rural labor market and promoting non-agricultural employment for rural labor.

Social trust, as an essential component of social capital, refers to the level of trust in strangers or the majority of people in society from the perspective of abstract and generalized information asymmetry. Social trust, as a necessary condition for promoting economic growth and improving social welfare, enhances the sense of equality and subjective well-being of rural labor, thereby positively promoting non-agricultural employment for rural labor. Information asymmetry in the real world has led to credit discrimination and resource misallocation in the financial market, making it difficult for disadvantaged groups, especially rural residents, to access equitable financial services [33]. Digital inclusive finance utilizes its advantages to promote socioeconomic equity and opportunity, granting more trust to rural labor in vulnerable positions in economic activities, alleviating social information asymmetry, and facilitating rural labor migration [34]. Additionally, with the progress of digital information technology and the strengthening of security measures, rural residents using digital inclusive finance can enjoy a good user experience and sufficient security protection [35]. The higher the level of trust in digital inclusive finance, the stronger the motivation for rural residents to hold financial assets, making it easier for them to reap the benefits brought by the development of digital inclusive finance and giving rural labor the strength and confidence to make career choices in non-agricultural employment. Based on the above analysis, this paper proposes the following research hypotheses:

H3a. Internet usage has a positive moderating effect on the impact of digital inclusive finance on non-agricultural employment of rural labor.

H3b. Social trust has a positive moderating effect on the impact of digital inclusive finance on non-agricultural employment of rural labor.

A lack of capital weakens the possibility of success for specific groups in contracting, making them relatively disadvantaged in the

[3] Data Source: Official website of the China Internet Network Information Center (CNNIC) (https://www.cnnic.net.cn/n4/2023/0828/c88-10829.html).

job market. Compared to traditional finance, digital inclusive finance, relying on digital technology innovation in financial service models, has brought new possibilities for disadvantaged groups such as rural labor through expanding financing channels, lowering financial thresholds, and alleviating financing constraints. Specifically, digital inclusive finance can promote entrepreneurship by improving residents' access to credit, easing financing constraints, and diversifying business risks [36]. The increase in entrepreneurship will release more job opportunities to the market, broaden the range of non-agricultural employment options for rural labor, and ultimately provide great convenience for non-agricultural employment of rural labor. Secondly, digital inclusive finance, relying on information technology such as big data and cloud computing, simplifies the loan approval process of financial institutions and improves the construction of personal credit systems in rural areas by continuously collecting basic personal data and forming information profiles. Therefore, digital inclusive finance, to a certain extent, alleviates financing constraints, enhances the accessibility of financial services, and facilitates non-agricultural employment for rural labor.

Due to limited education levels and financial literacy, most of China's rural population tends to be risk-averse, with relatively conservative risk preferences, which to some extent inhibits the initiative of rural labor to enter the job market and make entrepreneurial decisions. Planned behavior theory suggests that attitudes are essential factors determining behavior [37]. Workers with a high degree of risk aversion may choose to avoid high-risk entrepreneurship and prefer stable employment with steady returns. The development of digital inclusive finance may increase the risk preference of rural workers to some extent, thereby increasing their willingness to start businesses. On one hand, digital inclusive finance, leveraging financial technology information advantages, improves information asymmetry in the financial market, controls credit risks within a reasonable range using related algorithms, changes the attitudes of rural labor towards credit risks, and thus enhances their confidence and ability to utilize credit funds for entrepreneurship. On the other hand, technology-empowered digital inclusive finance is constantly generating new financial products. For example, rural workers can participate in diversified digital insurance services, enhancing resilience to risks during employment and entrepreneurship. Therefore, digital inclusive finance promotes non-agricultural employment of rural labor by increasing risk preference. Based on the above analysis, this paper proposes the following research hypotheses:

H4a. Digital inclusive finance can promote non-agricultural employment of rural labor by alleviating financing constraints.

H4b. Digital inclusive finance can promote non-agricultural employment of rural labor by increasing risk preference.

3. Research design and data description

3.1. Sample and data sources

The data used in this study mainly come from three sources. Firstly, the Digital Inclusive Finance Index of Peking University for the years 2018 and 2020. This index, compiled jointly by the Peking University Digital Finance Research Center and Ant Group, utilizes a large dataset, ensuring its representativeness. Secondly, the China Family Panel Studies (CFPS) conducted by the Peking University Institute of Social Science Survey. The CFPS survey data, initiated in 2010 and conducted biennially, include adult, family, and child questionnaires, providing comprehensive insights into China's socioeconomic changes and population trends. The information used in this study, such as non-agricultural employment status, internet usage, social trust, individual-level, and social security-related control variables, is sourced from the adult questionnaire, while family-related control variables are sourced from the family questionnaire. Thirdly, the China Statistical Yearbook for the years 2018 and 2020, as well as data from provincial statistical bureaus, are used for regional-level control variables.

Given that this study primarily analyzes labor market conditions, we define the sample age based on China's legal age for adults and the age range for eligible labor force. Specifically, we restrict the sample age to be between 18 and 58 years as of 2018, ensuring that the sample represents the labor force in 2020. Subsequently, using the individual's province of residence as the matching criterion, we match the CFPS data with the corresponding Digital Inclusive Finance Index for the same period. After eliminating invalid data such as missing values and outliers, the final valid sample size is 10,828.

3.2. Variable definitions

3.2.1. Dependent variable: non-agricultural employment (noag)

Drawing on existing research [38], the dependent variable in this study is non-agricultural employment, constructed based on the job nature variables in the CFPS adult questionnaire. If rural individuals are engaged in non-agricultural work, the value is 1; if engaged in agricultural work (farming, forestry, animal husbandry, sideline production, or fishing), the value is 0, thus generating a binary choice variable indicating whether non-agricultural employment is pursued.

3.2.2. Core independent variable: digital inclusive finance (dfi)

The core independent variable in this study is digital inclusive finance. Utilizing the "Peking University Digital Inclusive Finance Index (2011–2020)" as a reference to gauge the extent of digital inclusive finance development in China. This index is compiled by the Peking University Digital Finance Research Center and the Ant Group Joint Research Team. It has a certain representativeness for analyzing the development status of digital finance in China and its economic effects [39]. In addition to the overall index, this index also includes three sub-dimensions: the breadth of coverage of digital financial services (length), the depth of usage (depth), and the degree of digitalization (digital).

3.2.3. Mechanism variables

Internet usage (internet): The CFPS questionnaire includes inquiries regarding whether respondents "use mobile internet" and "use computer internet." Drawing from existing studies [40,41], this paper consolidates these two questions to indicate individual internet usage. Respondents answering "yes" are assigned a value of 1, otherwise, they are assigned a value of 0.

Social trust (trust): Drawing from previous research [24], the level of trust rural respondents have towards "strangers" in the questionnaire is used as a proxy variable for social trust. This rating ranges from 0 to 10, representing varying degrees of trust from very distrustful to very trusting.

3.2.4. Comparative explanatory variable: traditional inclusive finance

Presently, the academic community lacks a unified standard for the construction of the traditional inclusive finance indicator system. Drawing on existing research [42], and integrating data from the "China Statistical Yearbook" and relevant information released by the People's Bank of China, this paper formulates a traditional inclusive finance index based on three dimensions: bank penetration rate, bank system service utilization rate, and accessibility of bank services. By evaluating the development level of traditional inclusive finance through these three dimensions, the paper identifies and analyzes eight specific indicators. The composition of the indicator system is illustrated in Table 1.

To objectively measure the development level of traditional inclusive finance in China, this paper primarily adopts two measurement methods: the coefficient of variation method and the entropy method:

(1) The coefficient of variation method is used to standardize and weight each indicator, resulting in the final comprehensive development index. The specific calculation steps are as follows: Firstly, the original data for each indicator are normalized. Here, X_{ij} represents the dimensionless standardized indicator, with $max(X_{ij})$ and $min(X_{ij})$ denoting the maximum and minimum values of the j-th indicator under the i-th dimension, respectively.

$$X_{ij} = \frac{X_{ij} - min\ (X_{ij})}{max(X_{ij}) - min\ (X_{ij})}$$

Next, when calculating the coefficient of variation values for each indicator, S_j and μ_j respectively denote the standard deviation and mean of each indicator.

$$CV_j = \frac{S_j}{\mu_j}$$

Finally, confirm the weights of each indicator, ensuring that $0 \leq \rho_j \leq 1$.

$$\rho_j = \frac{CV_j}{\sum_{j=1}^{n} CV_j}$$

Traditional inclusive finance is defined as $tfi_i 1 = \sum_{i=1}^{n} (\rho_j \times X_{ij})$.

(2) Traditional inclusive finance calculated using the entropy method follows these specific steps:

Firstly, normalize the original data for each indicator, where X_{ij} represents the standardized dimensionless indicator as mentioned

Table 1
Indicator system of traditional inclusive finance index.

Primary dimension	Secondary dimension	Instructions	Evaluation indicators
Penetration rate	Bank branch coverage Rate	Number of bank branches per ten thousand people	Number of business outlets/ten thousand people
		Number of bank branches per ten thousand kilometers	Number of business outlets/ten thousand kilometers
	Bank employee coverage rate	Number of bank employees per ten thousand people	Number of employees/ten thousand people
		Number of bank employees per ten thousand kilometers	Number of employees/ten thousand kilometers
Usage rate	Deposit business	Proportion of GDP represented by various types of deposits in financial institutions	Deposit balance/GDP
	Loan business	Proportion of GDP represented by various types of loans in financial institutions	Loan balance/GDP
Accessibility		Per capita deposit balance in financial institutions	Deposit balance/total population
		Per capita loan balance in financial institutions	Loan balance/total population

above.

Next, calculate the entropy value ϕ_j for the j-th indicator. Here, $p_{ij} = x_{ij} / \sum_{i=1}^{n} x_{ij}$ represents the relative weight of the j-th indicator under the i-th dimension.

$$\phi_j = -\frac{1}{lnn} \sum_{i=1}^{n} p_{ij} lnp_{ij}$$

Finally, calculate the weights of each indicator.

$$w_j = \frac{(1-\phi_j)}{\sum_{j=1}^{n} (1-\phi_j)}$$

Traditional inclusive finance is defined as: $tfi_i 2 = \sum_{i=1}^{n} (w_j \times X_{ij})$.

Due to the relatively small values obtained from the calculation of the traditional inclusive finance index compared to the larger values of the Peking University Digital Inclusive Finance Index, the two have different scales. In order to facilitate the analysis and comparison of the differences in their impacts, this paper has standardized both the traditional inclusive finance index. Additionally, to mitigate potential endogeneity issues in the model, this paper employs a one-period lag to measure traditional inclusive finance.

3.2.5. Other variables

Drawing on relevant literature research and combining the characteristics of the CFPS database, this paper incorporates other variables that influence rural labor's non-agricultural employment mainly covering three aspects: Firstly, variables related to individual characteristics, such as gender (gender), age (age), marital status (marri), education level (edu), health status (health) and political profile (pstat) can be obtained from the adult questionnaire. Secondly, variables related to family characteristics, such as family size (size), family caregiving burden (support), and home ownership status (house), can be obtained from the household economic questionnaire. Thirdly, variables related to social security, such as medical insurance (medi), pension insurance (pension) and government subsidies (gov), can be obtained from the adult questionnaire. Lastly, variables related to regional characteristics, primarily reflecting the level and structure of regional economic development, such as the level of financial development (devel), improvement in fiscal expenditure structure (improve), and non-agricultural output ratio (nfram), can be obtained from the "China Statistical Yearbook" and various provincial statistical bureaus. Variable settings and descriptive statistics are shown in Table 2.

3.3. Model specification

To explore the influence of digital inclusive finance on non-agricultural employment among rural laborers, we begin by constructing an empirical model linking the two. Given that the dependent variable, non-agricultural employment, is a binary dummy variable, the baseline regression employs a Probit model for estimation. The specific model specification is as follows:

Table 2
Variable settings and descriptive statistics.

Variable name	Evaluation indicators	Mean	Std. Dev
noag	Rural household engaged in non-agricultural work = 1, otherwise = 0	0.53	0.49
dfi	Logarithm of the digital inclusive finance index	5.95	0.04
tfi1	Conventional inclusive finance index constructed in this paper (coefficient of variation method)	0.20	0.14
tfi2	Conventional inclusive finance index constructed in this paper (entropy method)	0.14	0.13
length	Logarithm of the coverage breadth index	5.70	0.09
depth	Logarithm of the depth of usage index	5.69	0.15
digital	Logarithm of the degree of digitalization index	5.74	0.10
internet	Use of mobile or internet on computer = 1, otherwise = 0	0.67	0.47
trust	Degree of trust in strangers, rated from 0 to 10, from low to high	7.78	2.26
gender	Male = 1, female = 0	0.51	0.50
age	Age of respondents when accepting the questionnaire survey	39.02	10.82
marri	Married = 1, otherwise = 0	0.84	0.37
edu	Scores from 0 to 5 represent illiterate/semi-illiterate, primary school, junior high school, senior high school/technical secondary school/vocational school, junior college, and bachelor's degree or above, respectively	2.08	1.41
health	Scores from 1 to 5 represent very unhealthy, fairly unhealthy, average, healthy, and very healthy, respectively	3.21	1.19
pstat	Communist Party member = 1, otherwise = 0	0.01	0.11
size	Total household population	4.77	2.09
support	Proportion of members aged below 6 and above 60 to the total household population	0.09	0.14
house	Presence of at least one self-owned housing unit in the family = 1, otherwise = 0	0.89	0.31
medi	Enjoyment of medical insurance = 1, otherwise = 0	0.91	0.28
pension	Participation in pension insurance program = 1, otherwise = 0	0.64	0.48
gov	Receipt of government subsidies = 1, otherwise = 0	0.55	0.49
devel	Ratio of total loans and deposits in the province to local GDP	3.67	0.90
improve	Ratio of financial support for agriculture to total fiscal expenditure	0.12	0.04
nfram	Ratio of non-agricultural GDP to regional GDP	0.90	0.03

$$Prob\left(noag_{ijt}=1\right)=\alpha_0+\alpha_1 dfi_{jt}+\alpha_2 X_{ijt}+\phi_j+\varnothing_t+\mu_{ijt} \quad (1)$$

$noag_{ijt}$ represents the binary indicator of whether individual i in province j in year t is engaged in non-agricultural employment; dfi_{jt} represents the level of development of digital inclusive finance; and X_{ijt} represents a vector of control variables capturing individual, household, social security, and regional characteristics affecting non-agricultural employment. All regressions include time and provincial fixed effects. The term ϕ_j represents provincial dummy variables to control for time-invariant omitted variables, $\varnothing_t$ represents year dummy variables to capture temporal trends in non-agricultural employment, and μ_{ijt} is the error term.

To further investigate the transmission mechanisms of internet usage and social trust on the impact of digital inclusive finance on non-agricultural employment of rural laborers, this paper extends Equation (1) by introducing the interaction terms of the two. The specific model specification is as follows:

$$Prob\left(noag_{ijt}=1\right)=\beta_0+\beta_1 dfi_{jt}+\beta_2 internet_{ijt}+\beta_3 dfi_{jt}\times internet_{ijt}+\beta_4 X_{ijt}+\phi_j+\varnothing_t+\mu_{ijt} \quad (2)$$

$$Prob\left(noag_{ijt}=1\right)=\gamma_0+\gamma_1 dfi_{jt}+\gamma_2 trust_{ijt}+\gamma_3 dfi_{jt}\times trust_{ijt}+\gamma_4 X_{ijt}+\phi_j+\varnothing_t+\mu_{ijt} \quad (3)$$

$internet_{ijt}$ represents internet usage, $trust_{ijt}$ represents social trust, $dfi_{jt}\times internet_{ijt}$ and $dfi_{jt}\times trust_{ijt}$ represent the interaction terms between internet usage, social trust, and the digital inclusive finance index, respectively. These terms are used to measure the moderating effects of internet usage and social trust on the impact of digital inclusive finance on non-agricultural employment of rural laborers. The meanings of other variables are consistent with Equation (1).

Table 3
The baseline regression results of digital inclusive finance on non-agricultural employment of rural labor.

Variables	(1)noag	(2)noag	(3)noag	(4)noag
dfi	1.772***	1.690***	1.515***	1.932***
	(0.100)	(0.101)	(0.104)	(0.244)
gender	0.103***	0.103***	0.105***	0.105***
	(0.008)	(0.008)	(0.008)	(0.008)
age	−0.011***	−0.012***	−0.011***	−0.011***
	(0.000)	(0.000)	(0.000)	(0.000)
marri	−0.031**	−0.011	−0.019	−0.025**
	(0.012)	(0.013)	(0.013)	(0.013)
edu	0.097***	0.094***	0.091***	0.089***
	(0.003)	(0.003)	(0.003)	(0.003)
health	0.006*	0.007**	0.006*	0.006*
	(0.004)	(0.003)	(0.003)	(0.003)
pstat	0.051	0.058	0.054	0.051
	(0.041)	(0.040)	(0.040)	(0.039)
size		−0.011***	−0.008***	−0.008***
		(0.002)	(0.002)	(0.002)
support		−0.011	0.001	0.002
		(0.029)	(0.028)	(0.028)
house		−0.124***	−0.111***	−0.107***
		(0.014)	(0.014)	(0.014)
medi			−0.030**	−0.028*
			(0.015)	(0.015)
pension			0.015*	0.007
			(0.009)	(0.009)
gov			−0.097***	−0.090***
			(0.008)	(0.008)
devel				0.015**
				(0.007)
improve				1.366***
				(0.239)
nfram				1.685***
				(0.178)
N	10828	10828	10828	10828
PseudoR2	0.232	0.240	0.251	0.259
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note: *, **, *** represent significance levels of 10 %, 5 %, and 1 %, respectively; robust standard errors are presented in parentheses; the table reports average marginal effects.

4. Empirical results and analysis

4.1. Baseline regression analysis

The baseline regression analysis results regarding the influence of digital inclusive finance on non-agricultural employment of rural labor are presented in Table 3. Each coefficient in the table represents the average marginal effect and controls for both time and provincial fixed effects. To mitigate the issue of omitted variables, control variables at the individual, household, social security, and regional levels are sequentially included in columns (1) through (4). The findings indicate that the estimated coefficients of digital inclusive finance are all significantly positive at the 1 % level, and the overall model fit remains stable. This suggests that digital inclusive finance effectively promotes non-agricultural employment among rural laborers. According to the regression results in column (4), for every one-unit increase in digital inclusive finance, the probability of rural labor engaging in non-agricultural employment increases by 193.2 %. This reflects the ability of digital inclusive finance to leverage its advantages, enabling rural laborers to access opportunities within the financial ecosystem and subsequently enhancing their likelihood of non-agricultural employment. Therefore, hypothesis H1 is supported.

Regarding control variables, individual characteristics such as gender, education level, and health status exert significant positive effects on rural labor's non-agricultural employment, while age exhibits a significant negative impact. This suggests that male individuals with higher education levels and better health are more inclined to pursue non-agricultural employment due to fewer constraints from marital and family responsibilities and increased availability of time and resources for such endeavors [43]. Additionally, higher education levels and better health status enhance rural laborers' prospects for securing non-agricultural employment opportunities, particularly in labor-intensive sectors. However, as age increases, the competitiveness of rural laborers in the non-agricultural employment market diminishes. Family characteristics, including household size and homeownership, negatively influence rural labor's non-agricultural employment. This may be attributed to the fact that non-agricultural employment often serves as a means to augment family income, with homeownership reflecting a family's economic status. Moreover, homeownership can restrict the economic mobility of family members, thereby reducing their likelihood of seeking employment outside the household. Larger families, typically comprising elderly and underage members, may prioritize familial obligations, further limiting the geographical scope of employment opportunities for rural laborers. Social security factors such as medical insurance and government subsidies also negatively impact rural labor's non-agricultural employment, as greater social security coverage reduces the propensity of rural households to opt for non-agricultural employment. Furthermore, regional characteristics such as the level of financial development, the composition of fiscal expenditure, and the ratio of non-agricultural output positively influence rural labor's engagement in non-agricultural employment. A higher degree of financial development, coupled with an optimized fiscal expenditure structure and a larger proportion of non-agricultural output, signifies enhanced access to financial resources at the local level, thereby augmenting the probability of rural labor participation in non-agricultural employment.

4.2. Analysis of the impact of digital inclusive finance across different dimensions

Further analysis of the impact of digital inclusive finance across various dimensions on non-agricultural employment of rural labor is presented in Table 4. Columns (1) through (3) include all potential control variables that may influence rural labor's non-agricultural employment. The results reveal that the estimated coefficients for different dimensions of digital inclusive finance are all significantly positive at the 1 % level. This indicates that the development of digital inclusive finance across these dimensions contributes to an increased likelihood of rural labor engaging in non-agricultural employment. Firstly, the breadth of coverage reflects the provision of financial services to diverse populations through the number of electronic accounts, unrestricted by geographical limitations under the new internet-based financial model, thus positively impacting non-agricultural employment. Secondly, the depth of usage, which encompasses total usage and activity levels, including payments, credit, and investment services, accurately delineates customer profiles through digital technologies such as big data and cloud computing. This provision of diverse and personalized financial tools

Table 4
Regression results of different dimensions of digital inclusive finance on non-agricultural employment of rural labor.

Variables	(1)noag	(2)noag	(3)noag
length	0.665***		
	(0.110)		
depth		0.453***	
		(0.073)	
digital			0.897***
			(0.122)
Controls	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	10828	10828	10828
PseudoR2	0.246	0.257	0.258

Note: *, **, *** represent significance levels of 10 %, 5 %, and 1 %, respectively; robust standard errors are presented in parentheses; the table reports average marginal effects.

meets the varied needs of rural residents, effectively boosting non-agricultural employment levels in rural areas. Lastly, the degree of digitization underscores convenience, affordability, and credit accessibility. Leveraging big data platforms, digitization reduces information asymmetry between financial institutions and small to medium-sized enterprises, enhancing finance accessibility for the latter. This facilitates business expansion, fosters enterprise transformation and upgrading, and ultimately generates more non-agricultural job opportunities in the market. Furthermore, digital inclusive finance offers inherent advantages of low entry barriers and costs. With higher digitization levels, vulnerable groups benefit from the convenience and informatization of digital financial services [44], thereby reducing the transfer and opportunity costs associated with transitioning to non-agricultural employment for rural laborers. This, in turn, increases the prospects for non-agricultural employment. Hence, Hypothesis H1 receives further validation.

4.3. Comparative analysis of traditional inclusive finance and digital inclusive finance

Utilizing the coefficient of variation method and the entropy method respectively, traditional inclusive finance was quantitatively assessed. The regression outcomes in Table 5 indicate a statistically significant positive relationship between traditional inclusive finance, measured through both methods, and the non-agricultural employment of rural labor at the 1 % significance level. This underscores the substantive impact of traditional inclusive finance on rural labor's engagement in non-agricultural activities. Comparatively, when juxtaposed with the impact of digital inclusive finance as elucidated in Table 4, traditional inclusive finance yields notably lower probabilities of enhancing rural labor's non-agricultural employment—28.7 % and 22.0 % respectively, in contrast to the substantial 193.2 % observed in the baseline regression results. The theoretical underpinning reveals that traditional inclusive finance, primarily orchestrated by conventional banking institutions, tends to prioritize affluent clients. Consequently, credit allocation predominantly gravitates away from the weaker agricultural sectors towards secondary and tertiary industries, and from rural to urban locales. This inherent bias limits the efficacy of traditional inclusive finance in fostering non-agricultural employment among rural laborers. Conversely, digital inclusive finance has undergone transformative advancements in operational modalities, business frameworks, expansive outreach to diverse demographics, and adept management of financial product service costs and risks. Embodied within are advantages encompassing swiftness, convenience, cost-effectiveness, and seamless information dissemination, thereby exerting a more robust and positive influence on rural labor's participation in non-agricultural employment endeavors. Therefore, hypothesis H2 is supported.

4.4. Endogeneity analysis and robustness testing

4.4.1. Endogeneity analysis

To mitigate potential biases arising from bidirectional causality and omitted variables in the estimation results, this study adopts a methodological approach similar to prior research [45], selecting the "distance between the provincial capital city and Hangzhou" (distance) as an instrumental variable for digital inclusive finance. This choice aims to address potential endogeneity concerns due to its fulfillment of two key criteria. Firstly, the development of digital inclusive finance demonstrates significant spatial dependency and positive spillover effects across different regions. As the distance from Hangzhou decreases, these spillover effects intensify [46], establishing a relevance between digital inclusive finance and proximity to the data source. Secondly, distance, as a naturally occurring geographic feature, exerts minimal influence on the current labor market and individual employment decisions, making it an exogenous variable that remains unaffected by digital inclusive finance development and satisfies the exclusion restriction.

Table 6 presents regression results after incorporating the instrumental variable into the baseline regression model. The first-stage results of the instrumental variable approach indicate its significant impact on estimating digital inclusive finance, with an F-statistic well above 10, satisfying the relevance requirement with the endogenous variable. Furthermore, the second-stage regression results reveal the Wald test's chi-square statistic to be significant at the 1 % level, confirming the absence of weak instrumental variable problems and validating the instrumental variable selection. Notably, as reported in column (2), even after introducing the instrumental variable, digital inclusive finance continues to exhibit a significant positive effect on rural labor's non-agricultural employment. This underscores the robustness of the baseline regression findings following the mitigation of potential endogeneity concerns.

Table 5
Regression results of traditional inclusive finance on non-agricultural employment of rural labor.

Variables	noag			
	(1)Coefficient of variation method	(2)Coefficient of variation method	(3)Entropy method	(4)Entropy method
tfi	0.275***	0.287***	0.495***	0.220***
	(0.031)	(0.074)	(0.039)	(0.085)
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	10828	10828	10828	10828
PseudoR2	0.011	0.247	0.016	0.254

Note: *, **, *** represent significance levels of 10 %, 5 %, and 1 %, respectively; robust standard errors are presented in parentheses; the table reports average marginal effects.

Table 6
Endogeneity analysis results.

Variables	(1)dfi	(2)noag
distance	−0.166***	12.829***
	(0.002)	(1.186)
Controls	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
N	10828	10828
First-stage F-statistic		4377.03
Wald test		117.04***

Note: * indicates P < 0.1, ** indicates P < 0.05, *** indicates P < 0.01; standard errors in parentheses; the table reports regression coefficients.

4.4.2. Robustness testing

To ensure the reliability of the baseline regression findings, this study employs several methods to assess their robustness. Firstly, one-period lag of digital inclusive finance: Recognizing the potential lag effect of digital inclusive finance, the analysis is repeated using the digital inclusive finance index lagged by one period. The regression results are reported in column (1) of Table 7. Secondly, exclusion of municipalities directly under the central government: Due to regional disparities in economic and social development in China, the impact of digital inclusive finance on non-agricultural employment of rural labor may not be generalizable to municipalities with relatively better economic and social development. Therefore, samples from Beijing, Tianjin, Shanghai, and Chongqing are excluded. Column (2) presents the re-estimated results after this exclusion. Thirdly, trimming of continuous variables: To mitigate the influence of outliers, the primary explanatory variable and related continuous variables are trimmed by 1 % from the top and bottom. Column (3) displays the corresponding regression analysis results. Fourthly, replacement with Logit model regression: Given that the dependent variable is binary, Logit model regression is employed to examine whether different regression methods lead to biased estimation results. The Logit model results are reported in column (4). Lastly, endogeneity correction: The development level of digital inclusive finance in the laborers' region is not entirely random but influenced by individual and family characteristics. To address potential self-selection bias, only rural laborers achieving non-agricultural employment locally are considered in the baseline regression. Samples where household registration differs from the current province of residence are excluded to obtain the net impact of digital inclusive finance on non-agricultural employment of rural labor. The results are shown in column (5). The estimation results of these five testing methods align closely with the baseline regression. The coefficients of digital inclusive finance are consistently significant at the 1 % level, indicating its positive impact on non-agricultural employment of rural labor and reaffirming the robustness of the baseline regression conclusions.

4.5. Examination of mechanisms of influence

4.5.1. Internet usage and social trust

On the basis of the theoretical analysis in the preceding sections, internet usage and social trust are identified as two crucial mechanisms through which digital inclusive finance influences non-agricultural employment of rural labor. To examine these mechanisms, this study employs "use of internet on mobile or computer" and "level of trust in strangers" as proxy variables for internet usage and social trust, respectively. Subsequently, interaction terms between these variables and digital inclusive finance are added to the baseline model for regression analysis. The results of mechanism testing are presented in Table 8.

The mechanism testing results for the relationship between internet usage and the development of digital inclusive finance in relation to rural non-agricultural labor employment are shown in column (1). The coefficient of the interaction term between digital inclusive finance and internet usage is significantly positive at the 10 % level, indicating that internet usage plays a positively moderating role in the relationship between digital inclusive finance and non-agricultural employment of rural labor. This is mainly because rural laborers can accumulate knowledge and skills through internet usage, which facilitates the acquisition of human capital

Table 7
Robustness testing regression results.

Variables	noag				
	One-period lag	Exclude some samples	Truncation	Logit model	Local household registration
dfi	0.845***	2.275***	1.989***	0.440***	1.900***
	(0.127)	(0.275)	(0.252)	(0.030)	(0.253)
Controls	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	10828	10577	10828	10828	9998
PseudoR2	0.257	0.256	0.260	0.274	0.260

Note: *, **, *** represent significance levels of 10 %, 5 %, and 1 %, respectively; robust standard errors are presented in parentheses; the table reports average marginal effects.

Table 8
The results of mechanism analysis: internet usage and social trust.

Variables	(1)noag	(2)noag
dfi	1.916***	1.893***
	(0.559)	(0.099)
internet	−1.778*	
	(1.056)	
dfi × internet	0.315*	
	(0.177)	
trust		−0.244***
		(0.029)
dfi × trust		0.040***
		(0.005)
Controls	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
N	10828	10828
PseudoR2	0.266	0.260

Note: *, **, *** represent significance levels of 10 %, 5 %, and 1 %, respectively; robust standard errors are presented in parentheses; the table reports average marginal effects.

and influences individual employment or entrepreneurial choices. By utilizing internet usage, rural laborers can leverage the advantages of digital inclusive finance to expand channels for accessing information related to non-agricultural employment, thereby reducing information asymmetry in the job search process. Additionally, digital technology, especially internet technology, expands the scope for learning, socializing, and participating in commercial activities for laborers, leading to the expansion of social networks and enhancing their competitiveness in the labor market. Therefore hypothesis H3a is supported.

The mechanism testing results for the relationship between social trust and the development of digital inclusive finance in relation to rural non-agricultural labor employment are shown in column (2). The coefficient of the interaction term between digital inclusive finance and social trust is significantly positive at the 1 % level, indicating that social trust plays a positively moderating role in the relationship between digital inclusive finance and non-agricultural employment of rural labor. This is primarily because in China, as a traditionally geographically and socially interconnected society, social trust facilitates information transmission and income enhancement. As the level of social trust among rural laborers increases, so does their acceptance of emerging phenomena such as digital inclusive finance. Through digital platforms, they can access more social network resources, thereby increasing opportunities for non-agricultural employment and further expanding channels for information acquisition. Therefore, hypothesis H3b is supported.

4.5.2. Financing constraint effect

Capital scarcity poses a significant constraint on entrepreneurial success, particularly in rural areas where financial constraints are more pronounced compared to urban regions [47]. In recent years, the emergence of digital inclusive finance, leveraging mature digital technologies, has addressed this issue by expanding the financial resources available to rural laborers. This, in turn, has bolstered their confidence and capacity to pursue employment opportunities beyond traditional agriculture, such as production, business, and entrepreneurship. By easing the difficulties and high costs associated with financing non-agricultural employment, digital inclusive finance has played a pivotal role in promoting rural laborers' transition to non-agricultural sectors. To assess whether digital inclusive finance facilitates non-agricultural employment by alleviating financing constraints, this study follows established methodologies [48], examining financing constraints across two dimensions: borrowing from family and friends, and borrowing from formal financial institutions. The dependent variables in columns (1) and (2) of Table 9 represent whether rural laborers have engaged in borrowing from family and friends or from formal financial institutions, respectively. The results indicate significantly positive coefficients for the core explanatory variables. This suggests that the development of digital inclusive finance substantially increases the likelihood of rural laborers accessing financing from both informal and formal sources, thereby mitigating financing constraints

Table 9
The results of mechanism analysis: financing constraints and risk preference effects.

Variables	Financing constraint effect		
	(1)Borrowing from family and friends	(2)Borrowing from formal financial institutions	(3)Risk preference effect
dfi	0.711***	3.653***	0.672***
	(0.160)	(0.168)	(0.195)
Controls	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	10828	10828	10828
PseudoR2	0.448	0.295	0.221

Note: *, **, *** represent significance levels of 10 %, 5 %, and 1 %, respectively; robust standard errors are presented in parentheses; the table reports average marginal effects.

and ultimately fostering non-agricultural employment opportunities. Possible reasons include: On one hand, digital financial platforms provide a more transparent lending environment, making loan transaction information more accessible and traceable. This helps to break geographical and interpersonal barriers, promoting the formation and development of peer-to-peer lending relationships among family and friends. On the other hand, digital financial services contribute to lowering transaction costs and risks, enhancing the efficiency and sustainability of institutional lending for rural laborers. Therefore, hypothesis Ha4 is supported.

4.5.3. Risk preference effect

Due to insufficient personal conditions and changes in the external environment, rural laborers inevitably encounter various risks, including market, financial, and technological risks, when selecting their occupations, leading to uncertainty in employment or entrepreneurship. Consequently, this paper posits that the development of digital inclusive finance can alter the risk preferences of rural laborers, thereby impacting their decisions regarding non-agricultural employment. However, since the CFPS questionnaire does not directly inquire about individual risk preferences, this study follows established research practices [49], employs the question "Does your family currently hold financial products such as stocks, funds, national bonds, trust products, foreign exchange products, etc.?" as a proxy variable for risk preferences. If respondents hold such risk products, it indicates a high risk preference, assigned a value of 1; otherwise, it is assigned a value of 0. The results in Column 3 of Table 9 indicate that the estimated coefficient of digital inclusive finance is 0.672, significant at the 1 % level, suggesting that digital inclusive finance significantly positively influences the risk preference of rural laborers. Consequently, the development of digital inclusive finance indeed enhances the level of risk preference among rural laborers, thereby affecting decisions regarding non-agricultural employment. Possible reasons include: On one hand, as more rural laborers utilize digital financial tools to manage and grow their financial assets, they gradually gain more economic security and confidence, thus becoming more willing to take on economic risks associated with non-agricultural employment. On the other hand, digital inclusive finance offers a wider range of more flexible financial products and services, catering to the diverse risk preferences and financial needs of rural laborers, thereby encouraging them to participate more actively in non-agricultural employment activities. Therefore, hypothesis H4b is supported.

4.6. Heterogeneity analysis

4.6.1. Non-farm employment heterogeneity analysis

The baseline regression results suggest that the development of digital inclusive finance promotes non-farm employment among rural laborers. However, it's essential to ascertain which specific type of non-farm employment is more likely to benefit from this development. Building upon existing research [50], this study further divides rural laborers' non-farm employment into employed and entrepreneurial types to explore the impact of digital inclusive finance on these distinct categories. In the CFPS database, employed non-farm laborers are assigned a value of 1, while those not employed are assigned 0. If the non-farm employment falls within private enterprises, individual businesses, or other self-employment categories, it is considered entrepreneurial and assigned a value of 1, otherwise, it is assigned 0. The results, as depicted in Table 10, reveal that both employed and entrepreneurial types of non-farm employment among rural laborers exhibit a significant positive association with digital inclusive finance at the 1 % significance level. This suggests that the extensive development of digital inclusive finance enables both employed and entrepreneurial rural laborers to access equal financial services and support, underscoring its inclusive nature. Comparatively, the coefficient for employed non-farm laborers is higher than that for entrepreneurial types. This discrepancy might stem from employed rural laborers facing more substantial credit constraints from traditional inclusive finance systems and possessing lower levels of trust and security in society. The inherent advantages of digital inclusive finance can thus mitigate credit constraints and strengthen mechanisms of social trust, thereby incentivizing rural laborers to pursue non-farm employment.

4.7. Individual heterogeneity

4.7.1. Gender heterogeneity

Specifically examining employment disparities between genders in the two categories of employed and entrepreneurial non-farm

Table 10
Regression results of the impact of digital inclusive finance on different types of non-farm employment.

Variables	noag			
	(1)Employed	(2)Employed	(3)Entrepreneurial	(4)Entrepreneurial
dfi	1.723***	0.892***	0.556***	0.350***
	(0.115)	(0.215)	(0.155)	(0.119)
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	10828	10828	10828	10828
PseudoR2	0.018	0.191	0.014	0.045

Note: *, **, *** represent significance levels of 10 %, 5 %, and 1 %, respectively; robust standard errors are presented in parentheses; the table reports average marginal effects.

employment, the results from Table 11 indicate significant differences in gender coefficients in both employed and entrepreneurial types. Specifically, although males demonstrate positive effects in both types of non-farm employment, these effects are not statistically significant. Conversely, females exhibit statistically significant positive effects at the 1 % significance level in both types of non-farm employment, contrasting with the "gender discrimination" observed in prior research. One potential explanation for this deviation is that in traditional labor markets, male human capital in rural areas significantly outweighs that of females, resulting in higher levels of non-farm employment among males. However, the inclusiveness of digital inclusive finance in recent years has greatly reduced individual employment time and physical requirements, thus mitigating gender differences' impact. This enables rural women, who often juggle multiple household responsibilities, to further engage in employment opportunities facilitated by inclusive digital technologies, such as e-commerce, online customer service, and online broadcasting, where they hold a comparative advantage. Furthermore, changes in lifestyle and production methods driven by digital technology have lightened the burden of household responsibilities on women, granting them more time and energy for employment or entrepreneurship [51]. When comparing the two categories, employed non-farm employment among females exceeds entrepreneurial non-farm employment. This is primarily due to the lack of entrepreneurial endowments, including capital, among female laborers, limiting their entrepreneurial opportunities. Additionally, rural women are constrained by traditional rural social norms, requiring them to devote more time to household affairs, thus limiting their available time for entrepreneurship.

4.7.2. Age heterogeneity

Due to variations in the level of acceptance and usage of digital inclusive finance among rural laborers across different age brackets, this study categorizes rural laborers into two groups: the youth group (aged 18–39) and the middle-aged to elderly group (aged 40–60). As indicated by the results in Table 12, there are significant disparities in age coefficients. Specifically, within the employed non-farm employment category, digital inclusive finance demonstrates a notably positive and statistically significant impact on the middle-aged to elderly group at the 1 % significance level, while its effect is not statistically significant for the youth group. Conversely, in the entrepreneurial non-farm employment category, digital inclusive finance exhibits a significant positive effect on the youth group at the 1 % significance level, but it is not significant for the middle-aged to elderly group. The primary rationale behind these findings lies in the differing preferences and tendencies of rural laborers across age groups. Middle-aged and elderly individuals typically prioritize stability over risk-taking, hence favoring employed non-farm employment opportunities. This suggests that digital inclusive finance could potentially offer more employment options to this demographic, underscoring its inclusive nature. Conversely, younger laborers are more dynamic and responsive to the benefits offered by digital inclusive finance. The accessibility, affordability, and credit availability facilitated by digital finance platforms empower rural youth, fostering a conducive environment for entrepreneurship. Moreover, mounting societal pressures, such as marriage and homeownership, incentivize young rural individuals to pursue entrepreneurship actively and seek non-farm employment opportunities to augment their income.

4.7.3. Regional heterogeneity

Given the uneven socio-economic development across regions in China, the impact of digital inclusive finance on non-farm employment among rural laborers varies. This study further subdivides the overall sample into three sub-samples: Eastern, Central, and Western regions. The regression results in Table 13 reveal that in employed non-farm employment, digital inclusive finance has a positive promoting effect on non-farm employment among rural laborers in the Eastern region, whereas this effect is not significant in the Central and Western regions. Regarding entrepreneurial non-farm employment, the estimated coefficient of digital inclusive finance is positive and significant in the Eastern region but negative in the Central and Western regions. The primary reason behind these findings is that although digital inclusive finance possesses inclusive characteristics, there are still developmental disparities among regions. The Eastern region exhibits more pronounced development compared to the Central and Western regions, with a more robust digital infrastructure that enables the release of more dividends from digital inclusive finance for rural laborers. Conversely, the digital infrastructure in the Central and Western regions is relatively weaker, posing greater challenges for rural laborers to access financial market information and affordable financial support. As a result, the promoting effect of digital inclusive finance has yet to materialize in these regions.

Table 11
Regression results of the impact of digital inclusive finance on non-farm employment by gender.

Variables	Employed		Entrepreneurial	
	(1)Male	(2)Female	(3)Male	(4)Female
dfi	0.475	1.288***	0.195	0.513***
	(0.311)	(0.293)	(0.169)	(0.168)
Controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	5468	5360	5468	5360
PseudoR2	0.125	0.259	0.046	0.050
Difference in coefficients and p-value	P = 0.0186		P = 0.0129	

Note: *, **, *** represent significance levels of 10 %, 5 %, and 1 %, respectively; robust standard errors are presented in parentheses; the table reports average marginal effects; p-values for testing differences between coefficients are computed using the seemingly unrelated estimation (SUEST) model test.

Table 12
Regression results of the impact of digital inclusive finance on non-farm employment by age.

Variables	Employed		Entrepreneurial	
	(1)Youth	(2)Elderly	(3)Youth	(4)Elderly
dfi	0.261	1.584***	0.525***	0.170
	(0.297)	(0.299)	(0.173)	(0.159)
Controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	5760	5068	5760	5068
PseudoR2	0.138	0.123	0.035	0.072
Difference in coefficients and p-value	P = 0.0006		P = 0.3644	

Note: *, **, *** represent significance levels of 10 %, 5 %, and 1 %, respectively; robust standard errors are presented in parentheses; the table reports average marginal effects; p-values for testing differences between coefficients are computed using the seemingly unrelated estimation (SUEST) model test.

Table 13
Regression results of the impact of digital inclusive finance on non-farm employment by region.

Variables	Employed			Entrepreneurial		
	(1)East	(2)Middle	(3)West	(4)East	(5)Middle	(6)West
dfi	1.122***	1.739	−0.415	0.777**	−3.042***	−0.085
	(0.388)	(1.221)	(0.936)	(0.377)	(0.619)	(0.377)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3742	2556	4408	3742	2556	4408
PseudoR2	0.172	0.155	0.159	0.044	0.047	0.038

Note: *, **, *** represent significance levels of 10 %, 5 %, and 1 %, respectively; robust standard errors are presented in parentheses; the table reports average marginal effects.

5. Conclusion and policy recommendations

Based on 2018 and 2020 data from the CFPS database and the Peking University Digital Inclusive Finance Index, this paper investigates the impact of digital inclusive finance on rural labor non-farm employment and its transmission mechanisms. The research findings indicate: Firstly, both digital inclusive finance and its sub-dimensions contribute to enhancing the level of rural labor non-farm employment. Compared to traditional inclusive finance, digital inclusive finance exhibits stronger inclusiveness and accessibility. This conclusion remains robust even after employing various robustness tests, including instrumental variable approaches. Secondly, internet usage and social trust positively moderate the relationship between digital inclusive finance and rural labor non-farm employment. Higher levels of internet usage and social trust amplify the marginal effect of digital inclusive finance. Furthermore, this paper verifies the mechanisms through which digital inclusive finance influences rural labor non-farm employment, including financing constraint effects and risk preference effects. Thirdly, there are differences in the impact of digital inclusive finance on different types of non-farm employment. For entrepreneurial non-farm employment, digital inclusive finance has a stronger stimulating effect on employed non-farm employment. Additionally, female populations and the Eastern region are more likely to benefit from the development of digital inclusive finance. Moreover, digital inclusive finance can provide entrepreneurial opportunities for young rural laborers and employment opportunities for middle-aged and elderly rural laborers.

Based on these conclusions, the following recommendations are proposed:

Firstly, it is crucial to recognize the positive role of digital inclusive finance in promoting non-farm employment among rural laborers in China. On one hand, we should systematically summarize the innovative experiences of digital inclusive finance practices during the pandemic, which can facilitate the digital employment development in rural areas. On the other hand, efforts should be made to disseminate knowledge about digital inclusive finance through financial institutions and other channels, enhancing rural residents' financial literacy and guiding them to use digital inclusive financial products appropriately to achieve non-farm employment. Simultaneously, by promoting the deep integration of digital inclusive finance and traditional finance, innovating digital inclusive finance products and service methods, and constructing complementary and mutually supportive financial service systems, we can alleviate credit constraints and increase the possibility of non-farm employment.

Secondly, we should seize the opportunities presented by the development of digital inclusive finance and leverage the positive moderating effects of internet technology and social trust on non-farm employment among rural laborers. This can contribute to high-quality employment and promote rural economic development. Local governments and national telecommunication enterprises should enhance the digital infrastructure in remote rural areas by promoting the widespread use of the internet, smartphones, and telecommunication networks. This will facilitate the coordinated development of offline digital infrastructure and online network channels. Additionally, we should deepen the regulatory reform of digital inclusive finance and coordinate regulatory efforts among

relevant departments under the deployment of the State Council's Financial Stability and Development Committee. This will ensure the stability and security of cross-border financial services, mitigate the negative impact of financial technology, and enhance overall social trust.

Lastly, we should adopt a dialectical approach to understand the differentiated impact of digital inclusive finance on different labor groups and rural non-farm employment in different regions and take targeted measures to avoid one-size-fits-all solutions. On one hand, policy support and guidance should be accelerated to fully unleash the gender dividend in the digital economy, promoting non-farm employment among rural labor, especially female labor. On the other hand, efforts should be made to strengthen digital infrastructure construction in central and western regions. This can be achieved by formulating a series of policies, such as tax cuts, subsidies for entrepreneurship, and guarantee loans, to continuously improve the level of digital inclusive finance development in these regions, thereby promoting local non-farm employment levels.

Data availability statement

Data will be made available on request, further inquiries can be directed to the corresponding author.

CRediT authorship contribution statement

Yan Wang: Writing – review & editing, Validation, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Yin Qi:** Writing – review & editing, Writing – original draft, Visualization, Investigation. **Yi Li:** Validation, Supervision, Software, Resources, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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