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Research on the Impact of Digital Finance on China's Urban-Rural Income Gap

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ABSTRACT

The integration of digital technology and traditional finance has further achieved the goal of low-cost and sustainable financial services and contributed to high-quality economic development. Based on the data from 31 provinces in China from 2011 to 2021, this paper empirically analyzes the impact of digital finance on the urban-rural income gap. The results show that digital finance can significantly narrow the income gap between urban and rural residents. The quantile test shows that the greater the urban-rural income gap, the stronger the role of digital finance in narrowing the urban-rural income gap. The threshold effect test shows that the narrowing effect of digital finance on the urban-rural income gap will first increase and then weaken with the continuous improvement of the development level. Heterogeneity analysis shows that the secondary indicators of digital finance can significantly narrow the urban-rural income gap, and the effect of depth of usage is the most obvious. Moreover, digital finance has a significantly stronger effect on narrowing the urban-rural income gap in the eastern region than in other regions. Therefore, we should vigorously promote the development of digital finance and give full play to its effectiveness in narrowing the urban-rural income gap.

KEYWORDS

Digital finance; Urban-Rural income gap; Threshold effect

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1. Introduction

China's overall economy has flourished since the reform and opening up, but the income gap between residents has also increased. In 2000, China's Gini coefficient reached the international warning line of '0.4' (Wang et al., 2005). Lee et al. (2019) believed that this income gap is mainly manifested in China's urban-rural income gap. Although with the development of the economy and the implementation of poverty alleviation policies and China's urban-rural income gap has narrowed, there is still room for continued convergence. There are many reasons for the income gap, including their own reasons, geographical environment reasons and so on, among which the degree of financial openness and reform is also one of the important reasons (Ni et al., 2022). Therefore, expanding the breadth and quality of financial services can help low-income people obtain financial aid, increase their operating and working guarantees, and increase their total income.

However, inclusive finance refers to the provision of appropriate and effective financial services to all sectors and groups of society with financial service needs at an affordable cost based on the requirements of equal opportunities and the principle of business sustainability. Starting from the two classifications of inclusive finance, Chen et al. (2022) believed that both direct inclusive finance and indirect inclusive finance will greatly promote economic growth and play a role in narrowing the urban-rural income gap. He and Du (2022) argued that inclusive finance can curb the urban-rural income gap by improving the quality of financial development. After emerging digital technologies are widely used in the development of inclusive finance, digital finance came into being. Relying on Big Data, Cloud Computing, Blockchain, and other scientific and technological means, digital finance aims to meet the financial needs of low-income groups in the range of financial exclusion, improve their defects and deficiencies in financial services, further enhance the breadth of financial services, so that they can obtain greater support in operation and work, and promote the continuous improvement of their income level. From a household perspective, Tian and Guo (2022) argued that digital finance can reduce the urban-rural income gap by increasing the holdings of household financial products and credit loans.

Based on the above background, this paper takes the data of 31 provinces in China from 2011 to 2021 as the research object, discusses the relationship between digital finance and the urban-rural income gap, and the different effects of digital finance on different urban-rural income gap regions, and analyzes the threshold effect of economic development level. This paper aims to analyze the impact of digital finance on the urban-rural income gap, to provide ideas for reducing the income gap and achieving common prosperity, and to provide references for subsequent digital finance research. The marginal contribution of this paper lies in two points: (1) Most of the existing literature mainly studies the linear relationship between digital finance and the urban-rural income gap. Based on the research of linear relationship, this paper innovatively chooses quantile regression to test the possible nonlinear relationship between them. (2) The existing literature mainly focuses on the relationship between digital finance and the urban-rural income gap, and on this basis, this paper innovatively analyzes the threshold effect of economic development levels and studies the effect of digital finance on the urban-rural income gap under different economic development levels.

2. Literature Review

2.1. Level 2 heading

The academic discussion on digital finance has developed for a long time. At present, there is no unified definition of digital finance, but in most literature and relevant government reports, it is called 'digital finance', 'fintech' and 'Internet finance' (Chen et al., 2021). According to Ozili (2018), digital finance refers to financial services provided through mobile phones, computers, the Internet, credit cards, etc., and digital finance is designed

to improve the efficiency of financial services. Starting from the relationship among digital finance, green finance and social financing, Besides, Ozili (2021) believed that digital finance is both a promotion and a mechanism channel for green finance and social financing, which can provide funds for individuals and enterprises to promote the development of sustainable green projects. By summarizing the development of China's digital finance over the years, Huang and Huang (2018) believed that digital finance refers to the model in which traditional financial institutions and Internet companies use digital technology to achieve financing, payment, investment and other new financial services.

Discussions on the urban-rural income gap in China are also improved. Lu (2018) argued that there is a nonlinear relationship between economic growth and income disparities and that urban-rural income disparities can be reduced by promoting labor mobility, improving resource allocation efficiency, and improving local living standards. Cheng et al. (2022) analyzed the compatibility between economic growth and common prosperity from the perspective of narrowing the urban-rural income gap and believed that the increase of per capita GDP can significantly narrow the urban-rural income gap, which is more obvious in the western region of China. From the perspective of urban expansion and development, Zhong et al. (2022) believed that urban expansion and development can significantly narrow the urban-rural income gap, and this effect is significantly stronger in the eastern and central regions than in other regions in China. Tang et al. (2022) focused on the effect of policy implementation and studied that China's targeted poverty alleviation policy can significantly narrow the urban-rural income gap, and the effect is stronger in the less developed western regions than in other regions in China.

However, there are relatively few studies on the relationship between digital finance and the urban-rural income gap. From the perspective of impact mechanism, Ji et al. (2021) believed that digital finance can increase jobs and promote rural residents' income by alleviating financial exclusion, broadening financing channels, and promoting residents' entrepreneurship, so as to narrow the urban-rural income gap. Starting from the income structure, Yu and Wang (2021) found that digital finance is conducive to narrowing the per capita disposable income gap between urban and rural areas, and can significantly narrow the urban-rural wage income, property income, and transfer income gap, but it has little effect on narrowing the net operating income gap. Song and Guo (2017) took specific influencing factors as the starting point, and believed that they would have an important impact on urbanization and industrial development, and thus play a role in narrowing the urban-rural income gap. Zhao et al. (2022), from the perspective of primary distribution and redistribution, believed that digital finance can significantly reduce the gap between urban and rural primary distribution and redistribution, thus narrowing the urban-rural income gap.

3. Theoretical Analysis

3.1. The Direct Impact of Digital Finance on Urban-Rural Income Gap

Li et al. (2022) took the relationship between digital finance and farmers' income growth as the research object and believed that digital finance can significantly increase farmers' income, and the promotion effect on farmers' income will be stronger with the deepening of digital finance development. First, digital finance can play a leading role in improving the efficiency of financial resource allocation. Under the influence of the 'polarization effect' and 'spillover effect', financial resources can spread from increasingly saturated towns to rural areas. Digital finance will invest idle funds into rural areas, develop the rural economy, implement rural revitalization projects, and help farmers develop digital economy to generate income, thereby reducing the urban-rural income gap. Second, digital finance can play its financial derivative function to narrow the urban-rural income gap through the inclusive effect. On the one hand, the coupling of digital technology and financial expertise can effectively guide farmers' joint ventures to implement corporate governance. On the other hand, digital finance introduces mobile payment into

rural areas, which can not only release the domestic consumption of some rural residents and promote economic growth, but also help the sales of local characteristic agricultural products and increase farmers' income to narrow the urban-rural income gap. Therefore, this paper proposes the following hypothesis:

Hypothesis H1a: Digital finance can significantly reduce the urban-rural income gap.

However, from the perspective of the Kuznets effect and threshold characteristics, Yao and Ma (2022) conducted the empirical analysis with a linear model and a nonlinear model and believed that digital finance is not conducive to narrowing the urban-rural income gap. Most areas of China have not yet crossed the inflection point of the U-shaped curve. With the continuous development of digital finance, the income gap between urban and rural areas in the region will continue to increase, and this effect will increase with the improvement of the economic development level until the economic development reaches a higher stage. The main reason is that the lack of integration of inclusive finance and digital technology makes it difficult for low-income groups to obtain basic financial services. And low-income groups often have insufficient knowledge of the Internet, digital technology, financial services, and so on, due to low levels of education. Korupp and Szydlik (2005) called this difference in the acquisition and processing of information caused by different levels of education the digital divide. The digital divide will continue to exacerbate the information blocking of information-poor groups, thereby reducing their opportunities and ways to increase income and continuing to increase the income gap. Therefore, this paper proposes the following hypothesis:

Hypothesis H1b: Digital finance can significantly increase the urban-rural income gap.

3.2. Threshold Effect of Digital Finance on Urban-Rural Income Gap

From the perspective of Chinese urban samples, Youxue (2022) argued that the impact of digital finance on the urban-rural income gap has a threshold effect and is closely related to the level of economic development. Under different economic development levels, the impact of digital finance on the urban-rural income gap is also different. Zhao (2020) analyzed the level of economic development as a threshold and believed that in areas with low economic levels, the development of digital finance will further widen the urban-rural income gap, while in areas with high economic levels, digital finance can significantly narrow the urban-rural income gap. The main reason may be that rural residents in areas with the underdeveloped economy have a low degree of participation in digital finance, and the breadth and depth of use of digital finance are also poor. Rural residents do not really enjoy the popularization benefits brought about by digital finance and feel less about the cost reduction and efficiency improvement generated by digital finance. As a result, the income of rural residents has not been greatly improved, and the urban-rural income gap has not been substantially reduced. On the other hand, rural residents in areas with the developed economy can understand and participate better in financial services activities, fully enjoy the operational efficiency improvement and production cost reduction brought about by digital finance, and increase their overall income level, which will further narrow the urban-rural income gap. The following hypothesis is therefore proposed:

Hypothesis H2: There is a threshold effect of economic development level between digital finance and the urban-rural income gap.

3.3. Heterogeneity of the Impact of Digital Finance on Urban-Rural Income Gap

From the dimensions of secondary indicators of digital finance, Wang et al. (2022) studied and believed that different dimensions such as coverage breadth, use depth, and digitization degree will promote farmers' income from different levels. The coverage layer emphasizes Internet payment accounts and their bound bank accounts, etc; the depth of use focuses on the actual use of Internet finance; the degree of digitization focuses on the convenience

and use of financial services. Chen et al. (2022) believed that compared with traditional finance, digital technology has greatly improved the breadth and frequency of its service popularization in rural areas, and played the inclusive function of digital finance, which helps to improve the income level of rural residents. The following hypothesis is therefore proposed:

Hypothesis H3a: The impact of different digital finance secondary indicators on the urban-rural income gap is heterogeneous.

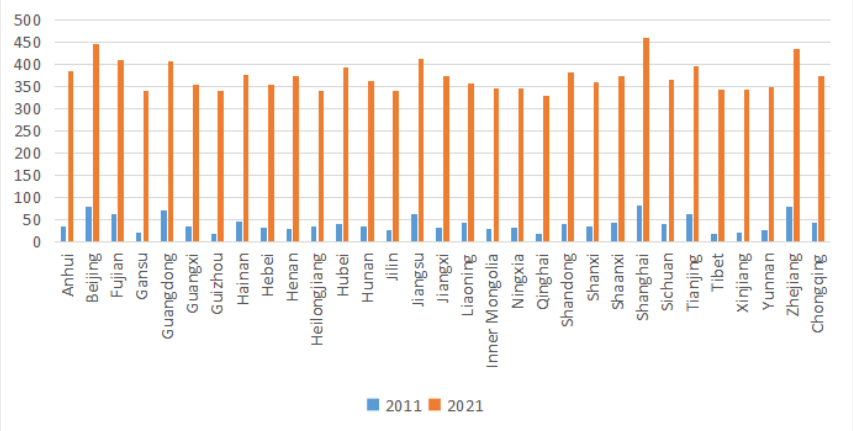
From the perspective of the whole country, Yang et al. (2022) believed that the effect of digital finance on the increase of farmers' credit supply in the eastern region is significantly stronger than that in the central and western regions, so the effect of digital finance on the increase of farmers' income has heterogeneity among different regions. Ye et al. (2022) took financial technology as the starting point, analyzed it from the perspective of regional differences, and believed that due to the different levels of economic development and investment in scientific and technological research and development in different regions, each region showed differences in the degree of financial technology innovation and development, and the effectiveness of digital finance was different as well. The impact of digital finance on the urban-rural income gap will also be different in different regions. The following hypothesis is therefore proposed:

Hypothesis H3b: The impact of digital finance on the urban-rural income gap in different regions is heterogeneous.

4. Status Analysis

4.1. The Development Status of Digital Finance

Taking the national provincial digital finance index for 2011 and 2021 as an example, this paper analyzed the development level of digital finance in each province, as shown in Figure 1. In 2011, digital finance indexes were higher in Jiangsu Province, Zhejiang Province, Guangdong Province, and other provinces, but the national digital finance index was low, the development of digital finance is in its infancy; while in 2021, the digital finance indexes of Shanghai, Beijing, Zhejiang Province, and other provinces were still higher, and there was a significant improvement of the digital finance indexes of all provinces in China. Digital finance can be so booming, not only in the construction of related infrastructure but also in the government's strong support for the development of digital finance. In vast areas, digital technology has sprung up, which lays a solid foundation for the development of digital finance. In the 2016 G20 Summit, it was proposed that digital finance is an important force to solve the rural financial dilemma, alleviate the financing constraints of low-income groups, and coordinate the development of urban and rural areas. It is necessary to vigorously develop digital finance to help the high-quality development of the economy and promote the reduction of the income gap to achieve common prosperity.

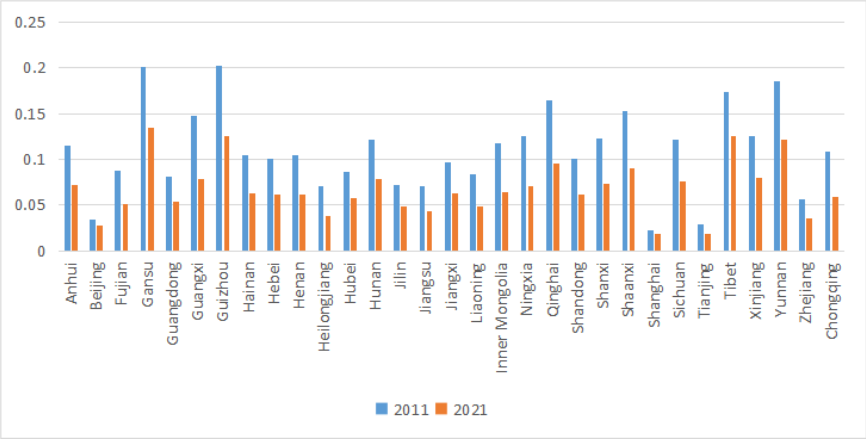


Data sources: The Peking University Digital Financial Inclusion Index of China(PKU-DFIIC)(2011-2021).

Figure 1. Development Status of Digital Finance.

4.2. The Status of Urban-Rural Income Gap

The Theil index is selected to measure the urban-rural income gap. Taking the Theil index of each province in 2011 and 2021 as an example, This paper analyzed the degree of the urban-rural income gap in each province, as shown in Figure 2. In 2011, the Theil indexes of Gansu Province, Guizhou Province, Qinghai Province, and other provinces were large, and the urban-rural income gap was obvious. While in 2021, the Theil indexes of Yunnan Province, Guizhou Province, Gansu Province, and other provinces were large, and the urban-rural income gap was obvious. However, in general, the Theil indexes of all provinces in the country showed a downward trend, and the urban-rural income gap in all provinces in the country is decreasing.



Data source: Wind Database.

Figure 2. Status of Urban-Rural Income Gap.

5. Empirical Research

5.1. Model Setting

This paper takes the panel data of 31 provinces, autonomous regions and municipalities in China from 2011 to 2021 as the research object, and sets the following model:

$$Theil_{i,t} = \alpha_0 + \alpha_1 lnDIFI_{i,t} + X_{i,t} + \theta_i + \mu_t + \varepsilon_{i,t} \quad (1)$$

n this model, i and t are province and year respectively; the explained variable $Theil_{i,t}$ represents urban-rural income gap; the core explanatory variable $lnDIFI_{i,t}$ is the logarithm of the digital finance index, indicating the level of the development of digital finance; $X_{i,t}$ represents control variables; θ_i represents individual fixed effects, μ_t represents time fixed effects, $\varepsilon_{i,t}$ represents a random error term.

5.2. Data Sources and Variable Description

This paper selects the panel data of 31 provinces in China from 2011 to 2021 as the research object. The data mainly comes from The Peking University Digital Financial Inclusion Index of China(PKU-DFIIC)(2011-2021), the China Statistical Yearbook, and Wind database.

Explained variable: urban-rural income gap. Referring to the research method of Zhong (2022), this paper selects the Theil index to measure the urban-rural income gap. The Theil index significantly reflects the income changes at both ends of the income, namely the urban population, and the rural population.

$$Theil_{i,t} = \sum_{j=1}^{2}\left(\frac{I_{ij,t}}{I_{i,t}}\right) ln \frac{\frac{I_{ij,t}}{P_{ij,t}}}{\frac{I_{i,t}}{P_{i,t}}} \quad (2)$$

In this formula, $j = 1$ represents the town; $j = 2$ represents the countryside; t represents the year, and i represents the region. $I_{ij,t}$ represents the disposable income of urban or rural residents in region i in year t. $P_{ij,t}$ represents the disposable income of urban or rural residents in region i or in region j in year t, $I_{i,t}$ represents the total income of residents in region i in year t. $P_{i,t}$ represents the population of region i in year t.

Core explanatory variable: digital finance index. Data is mainly from the Institute of Digital Finance in Peking University, including secondary indicators such as total index and breadth of coverage, depth of usage, and digitization level (Guo et al., 2020). In order to ensure the validity of the research results, this paper chooses to study the digital financial index and the secondary index.

Control variables: (1) Industrial structure level (Indus). Referring to the method of Song et al. (2022), the ratio of the added value of the tertiary industry to the regional GDP is used to measure the level of industrial structure. (2) The degree of financial development (Finan). Referring to the method of Song et al. (2022), the ratio of the added value of the financial industry to the regional GDP is selected to represent the degree of financial development. (3) R&D level. Referring to the method of Zhang et al. (2022), the ratio of local R&D investment expenditure to regional GDP is chosen to measure the level of R&D. (4) Degree of fiscal expenditure (Fisca). Drawing on the method of Ren (2022), the ratio of local fiscal general budget expenditure to regional GDP is selected to indicate the degree of fiscal expenditure. The descriptive statistical analysis of explanatory variables, explained variables, and control variables are shown in Table 1.

Table 1. Descriptive Statistical Results of Main Variables.

	Observations	Mean	Std. dev.	Min	Max
lnDIFI	341	5.2757	0.6767	2.7862	6.1290
lnCov	341	5.1348	0.8393	0.6729	6.0717
lnUse	341	5.2602	0.6553	1.9110	6.2358
lnDig	341	5.0670	0.7784	0	5.9389
Theil	341	0.0886	0.0395	0.0180	0.2020
Indus	341	0.4971	0.0887	0.3266	0.8373
Finan	341	0.0722	0.0307	0.0265	0.1963
R&D	341	0.0106	0.0062	0.0002	0.0324
Fisca	341	0.2930	0.2062	0.1068	1.3538
rgdp	341	10.8159	0.4519	9.6746	12.1225

5.3. Baseline Regression

In this paper, a two-way fixed effect model with fixed provinces and fixed time is selected for baseline regression analysis. Model (1) does not add any control variables, only with the province and time fixed; Model (2) adds various control variables on the basis of Model (1). The regression results are shown in Table 2. The coefficients of the digital finance index for the urban-rural income gap are all negative and significant at the 1 % level, which indicates that digital finance can significantly narrow the urban-rural income gap. Hypothesis H1a is validated.

Table 2. Baseline Regression Results.

	Model (1) Theil	Model (2) Theil
lnDIFI	-0.0252*** (-9.01)	-0.0243*** (-10.15)
Indus		-0.0363** (-2.37)
Finan		0.3170*** (7.77)
R&D		-0.5854*** (-3.92)
Fisca		0.0658*** (5.97)
Province	Control	Control
Year	Control	Control
cons	0.1998*** (19.76)	0.1828*** (16.32)
R^2	0.8622	0.9073
n	341	341

*Notes: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. The values in brackets are the clustering robust standard errors of the estimated coefficients of each variable.*

5.4. Quantile Test

In order to test the heterogeneity of the impact of digital finance on different urban-rural income gap provinces, this paper chooses to conduct a quantile regression test on the relationship between explanatory variables and explained variables. The regression results are shown in Table 3. The impact of digital finance on the urban-rural income gap at different quantiles is significantly heterogeneous. At the 0.1 quantiles, the coefficient of digital finance on the urban-rural income gap is not significant; from 0.3 quantiles to 0.9 quantiles, the coefficient of digital finance on the urban-rural income gap is negative and significant at 1% level, which shows an increasing trend. In general, the role of digital finance in narrowing the urban-rural income gap will increase with the increase of the urban-rural income gap. The greater the urban-rural income gap, the stronger the narrowing effect of digital finance.

Table 3. Quantile Test Results.

	Q=0.1	Q=0.3	Q=0.5	Q=0.7	Q=0.9
lnDIFI	-0.0048 (-0.96)	-0.0065*** (-3.31)	-0.0089*** (-2.99)	-0.0120*** (-3.26)	-0.0134*** (-2.80)
Indus	0.0022 (0.03)	-0.0764*** (-2.59)	-0.0955** (-2.21)	-0.0436 (-1.12)	-0.0168 (-0.36)
Finan	-0.6132*** (-3.52)	-0.2731*** (-2.93)	-0.1901 (-1.57)	-0.4008*** (-4.45)	-0.5606*** (-4.49)
R&D	-0.3507 (-0.82)	-1.7846*** (-5.93)	-2.1040*** (-8.27)	-2.2815*** (-7.12)	-2.3612*** (-4.28)
Fisca	0.0720*** (4.76)	0.0585*** (13.03)	0.0513*** (9.85)	0.0502*** (3.75)	0.2001*** (3.40)
cons	0.1112*** (4.76)	0.1705*** (11.96)	0.2005*** (9.85)	0.2204*** (10.44)	0.2140*** (7.55)
R^2	0.4445	0.4373	0.4268	0.4229	0.4273
n	341	341	341	341	341

*Notes: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. The values in brackets are the clustering robust standard errors of the estimated coefficients of each variable.*

5.5. Threshold Effect Test

In order to examine the impact of economic development on the relationship between digital finance and the urban-rural income gap, the degree of economic development is studied as a threshold variable. This paper chooses the logarithm of the per capita GDP (rgdp) of each province to measure the degree of economic development. The results of the threshold effect analysis are shown in Table 4 and Table 5. The first threshold value and the second threshold value are 10.1245 and 11.4327 respectively, and both pass the 1% level significance test respectively, indicating that economic development has a threshold effect on the narrowing effect of digital finance on the urban-

rural income gap. As is shown in Table 3, it is a statistical diagram of the double threshold effect of economic development level.

Table 4. Threshold Effect Test.

Variable	Threshold	Fstat	Prob	BS	Crit10	Crit5	Crit1
rgdp	Single	73.36	0.0000	500	26.3220	31.8115	45.3225
rgdp	Double	38.90	0.0000	500	25.7485	36.3058	73.2319

Table 5. Threshold Values.

Threvar	Threshold	Threshold Index	[95% conf, interval]
rgdp	Single	10.1245	[10.0892，10.1617]
rgdp	Double	11.4327	[11.3719，11.4539]

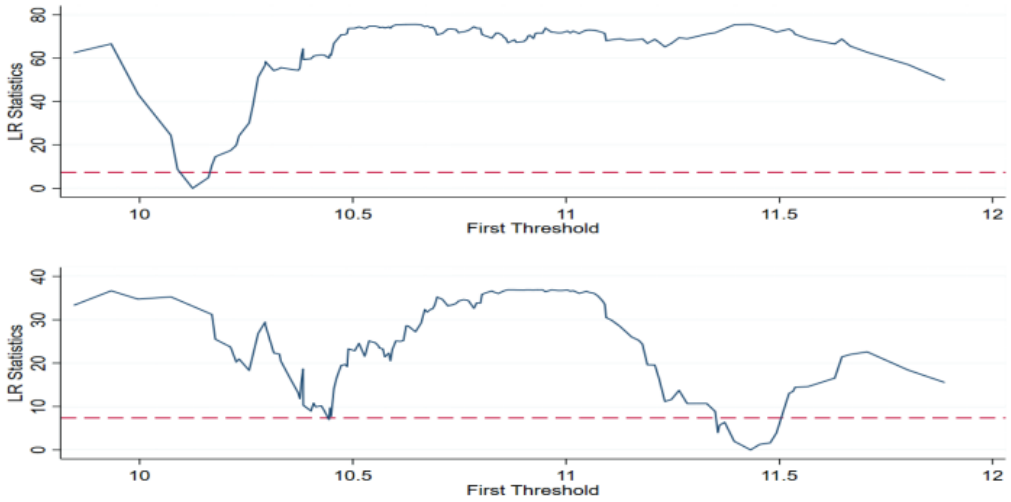


Figure 3. Diagram of the Double Threshold Effect.

The regression results are shown in Table 6. At a lower level of economic development (rgdp ≤ 10.1245), the coefficient of digital finance and urban-rural income gap is -0.0094 and significant at the 5% level. At the level of medium economic development (10.1245 < rgdp ≤ 11.4327), the coefficient of digital finance and urban-rural income gap is -0.0126, which is significant at the 1% level. At a higher level of economic development (rgdp > 11.4327), the coefficient of digital finance and urban-rural income gap is -0.0114, which is significant at the 1% level. This shows that the effect of digital finance on narrowing the urban-rural income gap increases first and then decreases with the continuous improvement of the level of economic development. Hypothesis H2 is validated.

Table 6. Threshold Test Results.

	lnDIFI
rgdp ≤10.1245	-0.0094** (-2.26)
10.1245 < rgdp≤11.4327	-0.0126*** (-3.17)
rgdp > 11.4327	-0.0114*** (-2.80)
Control Variables	Control
Province	Control
Year	Control
cons	0.1429*** (7.95)

R2	0.9300
n	341

*Notes: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. The values in brackets are the clustering robust standard errors of the estimated coefficients of each variable.*

5.6. Heterogeneity Test

5.6.1. Heterogeneity of Digital Finance

The digital financial index can be composed of three secondary indicators: coverage breadth, depth of usage, and digitization level. Therefore, this paper analyzes its impact on the urban-rural income gap from the perspective of coverage breadth, depth of usage, and digitization level. The regression results are shown in Table 7. The coefficients of coverage breadth, depth of usage, and digitization level for the urban-rural income gap are all negative, and both are significant at the 1 % level. Especially, the depth of usage has a significantly stronger effect on narrowing the urban-rural income gap than the coverage breadth and digitization level. Hypothesis H3a is validated.

Table 7. Heterogeneity of Digital Finance Results.

	(1) Theil	(2) Theil	(3) Theil
lnCov	-0.0101*** (-10.51)		
lnUse		-0.0193*** (-9.87)	
lnDig			-0.0064*** (-6.53)
Indus	-0.0411** (-2.70)	-0.0488*** (-3.12)	-0.0472*** (-2.75)
Finan	0.3099*** (7.68)	0.3902*** (9.28)	0.3538*** (7.86)
R&D	-0.6152*** (-4.15)	-0.7538*** (-4.98)	-0.6674*** (-4.10)
Fisca	0.0661*** (6.04)	0.0718*** (6.47)	0.0773*** (0.45)
Province	Control	Control	Control
Year	Control	Control	Control
cons	0.1301*** (18.12)	0.1687*** (16.45)	0.1185*** (14.65)
R2	0.9055	0.9024	0.8865
n	341	341	341

*Notes: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. The values in brackets are the clustering robust standard errors of the estimated coefficients of each variable.*

5.6.2. Heterogeneity of Region

According to the common division method in China, the whole country is mainly divided into Northeast China, Eastern China, Central China, and Western China for regional heterogeneity analysis. The regression results are shown in Table 8. In the northeast, central and western regions, the coefficients of digital finance and the urban-rural income gap are not significant. While in the eastern region, the coefficient of digital finance and the urban-rural income gap is negative and significant at the 1 % level, indicating that digital finance can significantly narrow the urban-rural income gap in the eastern region. Hypothesis H3b is validated.

Table 8. Heterogeneity of Region Results.

	(1) Northeast	(2) East	(3) Middle	(4) West
lnDIFI	-0.0052 (-0.70)	-0.0301*** (-7.77)	0.0112 (1.09)	-0.0062 (-1.29)
Indus	-0.1638** (-2.54)	-0.0605** (-2.59)	-0.0971*** (-3.18)	-0.0424* (-1.81)

Finan	0.2005 (0.77)	0.2753*** (7.75)	0.6177*** (5.83)	0.2308*** (3.82)
R&D	-0.9365* (-2.09)	-0.6106*** (-4.78)	-0.1057 (-0.37)	0.8490* (1.93)
Fisca	0.0549* (2.06)	0.0146 (0.66)	-0.0173 (-0.44)	0.0279** (2.01)
Province	Control	Control	Control	Control
Year	Control	Control	Control	Control
cons	0.1458*** (4.24)	0.2069*** (12.35)	0.0890** (2.58)	0.1633*** (7.95)
R2	0.9877	0.9370	0.9793	0.9541
n	341	341	341	341

*Notes: *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. The values in brackets are the clustering robust standard errors of the estimated coefficients of each variable.*

6. Research Conclusions and Policy Recommendations

6.1. Research Conclusions

Based on the provincial data from 2011 to 2021, this paper discusses the relationship between digital finance and the urban-rural income gap. The research conclusions show that: (1) Digital finance can significantly narrow the income gap between urban and rural residents; (2) The greater the urban-rural income gap, the stronger the role of digital finance in narrowing the urban-rural income gap; (3) With the continuous improvement of economic development level, the role of digital finance in narrowing the urban-rural income gap increases firstly and then decreases; (4) In terms of the heterogeneity of digital finance, each secondary index of digital finance can significantly narrow the urban-rural income gap, and the effect of depth of usage is the most obvious; in terms of heterogeneity of the region, digital finance has a significantly stronger effect on narrowing the urban-rural income gap in the eastern region than in other regions in China.

6.2. Policy recommendations

First, the government should improve the quality of digital finance vigorously. The government should build Internet infrastructure in rural and remote areas actively. Inadequate Internet coverage, backward mobile devices, and low network speeds in rural areas may create a 'digital divide' between urban and rural areas, which increases the urban-rural income gap. Therefore, the government should continue to increase the construction of Internet infrastructure, improve infrastructure upgrading, and promote the popularization and development of financial services businesses at present, in order to further build a digital highway and narrow the urban-rural income gap.

Second, the government should optimize the digital financial environment comprehensively. The rise of digital finance requires a supporting regulatory system. However, compared with traditional finance, digital finance started late and its supporting regulatory systems are relatively weak. Therefore, the government should make full use of all kinds of cutting-edge digital technologies to build a targeted digital financial regulatory mechanism in a timely manner, ensure the healthy and sustainable development of digital finance, prevent the occurrence of systemic risks, and play its important role in narrowing the urban-rural income gap effectively.

Finally, the government should promote the popularization of digital finance knowledge. The development of digital finance mostly started in regions with developed economies. On the one hand, it benefits from the rapid economic development of the region, and on the other hand, it benefits from the relatively complete financial knowledge and related digital technology mastery of regional users. Therefore, the government should improve the ability of rural residents vigorously to master digital technology and the cognitive level of digital finance, so that rural residents can overcome the 'opportunity exclusion' and understand and participate in digital financial services actively. The government should enhance the penetration of digital finance in the whole society comprehensively

and reduce the urban-rural income gap by improving the economic behavior of residents in rural areas.

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Conflict of interest

All the authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

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