

A Study on the Impact of Digital Inclusive Finance on the Urban-Rural Income Gap

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Abstract:

Chinese provincial panel data from 2011-2020 are selected to empirically demonstrate the impact of digital inclusive finance and its sub-dimensional indices on the urban-rural income gap using a panel fixed effects model. The findings show that digital inclusive finance narrows the urban-rural income gap in China, and the conclusions still hold after using instrumental variables to deal with endogeneity; there is regional heterogeneity in the effects of digital inclusive finance and its sub-dimensional indices on the urban-rural income gap.

Keywords: digital inclusive finance; urban-rural income gap; regional heterogeneity; fixed effects model

I Introduction

Narrowing the income gap between urban and rural areas is an important tool to promote the common prosperity of all people in the new development stage, which is beneficial to better promote the realization of coordinated development of urban and rural areas[1]. According to the relevant data from the National Bureau of Statistics, the ratio of per capita disposable income of urban and rural residents in 2021 is 2.50 (rural residents' income = 1), down 0.38 from 2012, and the relative income gap between urban and rural residents continues to narrow. As a new generation of financial industry integrating digital technology and inclusive finance, the impact of digital inclusive finance on the urban-rural income gap in China should not be underestimated. Therefore, this paper focuses on how digital inclusive finance affects the urban-rural income gap? Is there any regional heterogeneity in its effect?

First, existing studies still disagree on how financial development affects the urban-rural income gap[2]. One part of the research argues that financial services have the characteristic of disliking the rich and the poor, and credit resources tend to flow to urban areas, leading to a widening urban-rural income gap[3]. Another study argues that financial development increases investment and financing opportunities, stimulates the development of the real economy, provides more employment opportunities and credit services for low-income groups such as farmers, and reduces the urban-rural income gap[4]. In addition, other studies find that the impact of financial development on the urban-rural income gap shows a non-linear relationship[5].

Second, since the United Nations Year of Microfinance in 2005, when the concept of financial inclusion was

introduced, the study of the impact of financial inclusion on the urban-rural income gap has gradually attracted widespread attention from scholars at home and abroad, and the findings are mixed. Some studies have found that inclusive finance can narrow the urban-rural income gap[6]. Inclusive finance reduces the urban-rural income gap by lowering the threshold of financial services and alleviating the incidence of poverty[7]. Other studies suggest that financial inclusion widens the rural-urban income gap. Inclusive finance can limit its effectiveness in narrowing the rural-urban income gap if there are high credit thresholds, inadequate supporting mechanisms, or a lack of financial technology tools[8].

To sum up, the organic integration of digital technology and inclusive finance has given rise to a new business model of digital inclusive finance, which brings light to solve the long-term financial repression in China and provides a valuable opportunity to address the urban-rural income gap. Therefore, this paper will focus on the impact of digital inclusive finance on urban-rural income disparity and its regional heterogeneity to provide empirical reference and theoretical reference for solidly promoting common prosperity and the orderly and healthy development of digital inclusive finance in the new era.

II Theoretical analysis

Digital inclusive finance focuses on narrowing the urban-rural income gap by saving financial transaction costs, improving information transparency and market openness, and reducing credit constraints for low-income groups such as farmers. Specifically, firstly, digital financial services provide accurate information support for financial institutions, reduce the operating costs of financial institutions, make it easier for financial institutions to enter the rural market, provide credit support for farmers,

and increase farmers' income[9]; secondly, digital inclusive finance provides an information service platform for farmers to obtain funds, improves the transparency of credit information and the openness of the rural financial market, and helps farmers and other low-income groups better production plans and increase farmers' income; finally, digital inclusive finance enhances the financial inclusion of rural residents, helps farmers and other low-income groups share the dividends of financial inclusion, and effectively alleviates the credit constraints of farmers and other low-income groups[10]. Therefore, theoretically, the development of digital inclusive finance can narrow the urban-rural income gap.

From the perspective of three dimensions of digital inclusive finance, first, the breadth of digital inclusive financial coverage focuses on the coverage of financial services. The more groups that can access digital inclusive financial services, the higher the breadth of development, the higher the possibility of narrowing the urban-rural income gap. Second, the degree of digital inclusive financial usage represents the extent to which residents use digital inclusive financial services. The stronger the residents use financial services, the higher the depth of usage, and the stronger the ability to narrow the urban-rural income gap. Third, the degree of digitalization measures the degree of convenience brought by digital inclusive finance, which is very likely to induce the phenomenon of "digital divide", resulting in the exclusion of farmers and other low-income people from the financial system and continuously widening the urban-rural income gap.

Based on the theoretical analysis, the research hypotheses 1-3 of this paper are proposed:

Hypothesis 1: There is a negative effect of digital inclusive finance on the urban-rural income gap.

Hypothesis 2: There is a negative effect of the breadth of coverage of digital inclusive finance on the urban-rural income gap

Hypothesis 3: There is a negative effect of the depth of use of digital inclusive finance on the urban-rural income gap

Hypothesis 4: There is a positive effect of the digitalization of digital inclusive finance on the urban-

rural income gap.

3 Research Design

(i) Model setting

This paper empirically tests the impact of digital inclusive finance on the urban-rural income gap using panel data for 31 provinces, autonomous regions and municipalities in China from 2011 to 2020, setting the following benchmark regression model:

$$Theil_{it} = \alpha_0 + \alpha_1 \ln(DIF_{it}) + \sum_{j=1}^k \lambda_j X_{jt} + \mu_i + \gamma_t + \varepsilon_{it} \quad (1)$$

where $Theil_{it}$ denotes urban-rural income gap in i Province in t -th year. $\ln(DIF)$ denotes the logarithmic value of digital financial inclusion development in i Province in t -th year. X denotes the control variables introduced in model (1) above, including the logarithm of real GDP per capita, urbanization rate, industrial structure, level of traditional financial development, fiscal support ratio for agriculture, and education per capita. γ and μ denotes individual fixed effects and time fixed effects, respectively, ε denotes random disturbance terms.

To explore in depth the linear effects of the breadth of coverage, depth of use and digitization of digital inclusive finance on the urban-rural income gap, the following models (2)-(4) are constructed in turn:

$$Theil_{it} = \alpha_0 + \alpha_1 \ln(DIFuse_{it}) + \sum_{j=1}^k \lambda_j X_{jt} + \mu_i + \gamma_t + \varepsilon_{it} \quad (2)$$

$$Theil_{it} = \alpha_0 + \alpha_1 \ln(DIFdep_{it}) + \sum_{j=1}^k \lambda_j X_{jt} + \mu_i + \gamma_t + \varepsilon_{it} \quad (3)$$

$$Theil_{it} = \alpha_0 + \alpha_1 \ln(DIFdig_{it}) + \sum_{j=1}^k \lambda_j X_{jt} + \mu_i + \gamma_t + \varepsilon_{it} \quad (4)$$

Where $\ln(DIFuse_{it})$, $\ln(DIFdep_{it})$ and $\ln(DIFdig_{it})$ denote respectively the logarithmic values of the breadth of digital financial coverage, depth of use and digitalization index of financial inclusion in the province year.

(ii) Variable selection and data sources

The primary data in this paper are mainly from China Statistical Yearbook and Peking University Digital Inclusive Finance Index and wind database. The variables are selected and summarized in Table 1.

Table 1 Variable names and measurement descriptions

Variable Type	Variable Name	Calculation method
Explained variables	Urban-rural income gap (<i>theil</i>)	See Equation 5 for details
Explanatory variables	Digital Financial Inclusion Index (<i>DIF</i>)	Digital Financial Inclusion Index
	Breadth of coverage(<i>DIFuse</i>)	Breadth of Coverage Index
	Depth of use (<i>DIFdep</i>)	Depth of use index

Explanatory variables	Degree of digitization (<i>DIFdig</i>)	Digitization index
Control variables	Degree of economic development (<i>Lgdp</i>)	Real GDP per capita in logarithm
	Urbanization rate (<i>urban</i>)	Regional urban population/total regional population
	Industrial structure (<i>is</i>)	Value added of secondary and tertiary industries/GDP
	Traditional financial development (<i>fd</i>)	Value added of financial industry/GDP
	Financial support for agriculture (<i>afe</i>)	Agriculture, forestry and water expenditure/GDP
	Education level (<i>edu</i>)	Average number of students enrolled in higher education per 100,000 population

The urban-rural income gap measures in Table 1 are measured using the Thayer index, as shown in the following formula (5):

$$theil_{it} = \sum_{j=1}^2 \left[\frac{p_{ij,t}}{p_{i,t}} \right] \ln \left[\frac{p_{ij,t} / z_{ij,t}}{p_{i,t} / z_{i,t}} \right] \quad (5)$$

Where $j = 1, 2$ represent urban and rural areas respectively. $z_{i,t}$ indicates the total population of the i province in t -th year. $z_{ij,t}$ denotes the urban population. $p_{i,t}$ denotes total disposable income, $p_{ij,t}$ indicates the disposable income of urban or rural residents. Total regional income is measured by multiplying regional population by regional disposable income per capita.

The core explanatory variables are the Digital Inclusive Finance Index (*DIF*) and the sub-dimensional indices. In this paper, the Digital Inclusive Finance Index and its sub-dimensional indices released by the Digital Finance Research Center of Peking University are used to

characterize the level of digital inclusive finance in China. The breadth of coverage index (*DIFuse*) reflects the ability of digital inclusive finance to reach customers; the depth of use index (*DIFdep*) is a composite of the number of people using digital inclusive finance, the degree of active use and the intensity of use. The digitalization degree (*DIFdig*) reflects the level of threshold and convenience of using digital inclusive finance.

The control variables include the degree of economic development, urbanization rate, industrial structure, degree of traditional financial development, financial support to agriculture, and education level. The specific measurements are shown in Table 1.

(iii) Descriptive statistics

In this paper, the panel data of 31 provinces in China from 2011 to 2020 are selected, and the descriptive statistics of specific variables are shown in Table 2.

Table 2 Descriptive statistics of variables

Variable	N	Mean	p50	SD	Min	Max
<i>theil</i>	310	0.0910	0.0850	0.0400	0.0180	0.202
$\ln DIF$	310	5.212	5.410	0.677	2.786	6.068
$\ln(DIFuse)$	310	5.060	5.284	0.844	0.673	5.984
$\ln(DIFdep)$	310	5.195	5.313	0.651	1.911	6.192
$\ln(DIFdig)$	310	5.510	5.778	0.698	2.026	6.136
<i>Lgdp</i>	310	8.149	8.096	0.340	7.523	9.213
<i>urban</i>	310	0.581	0.570	0.131	0.227	0.896
<i>is</i>	310	9.800	9.750	5.233	0.300	25.80
<i>fd</i>	310	0.0710	0.0670	0.0300	0.0260	0.196
<i>afe</i>	310	0.0380	0.0260	0.0370	0.00800	0.262
<i>edu</i>	310	2608	2424	812.1	1082	5613

Initial Experience Judgment

In order to observe the linear relationship between digital inclusive finance and its sub-dimensional indices on the urban-rural income gap more intuitively, this paper provides a preliminary portrayal of the above four sets of quantitative relationships with the help of scatter plots, as shown in Figure 1, where (a)-(d) in Figure 1 correspond to

the core explanatory variables of digital inclusive finance and its three sub-dimensional indices, respectively. It is not difficult to find that the hypotheses 1-4 proposed in this paper are initially confirmed, and the specific quantitative relationships are subject to further empirical analysis in later sections.

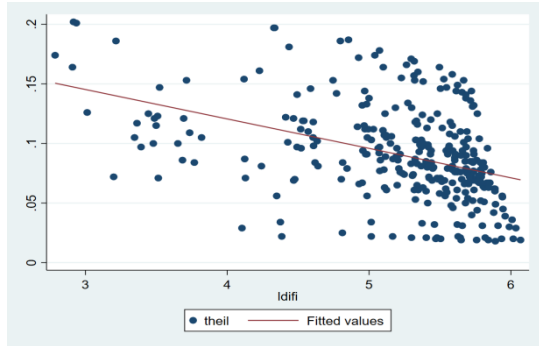


图 1 (a)

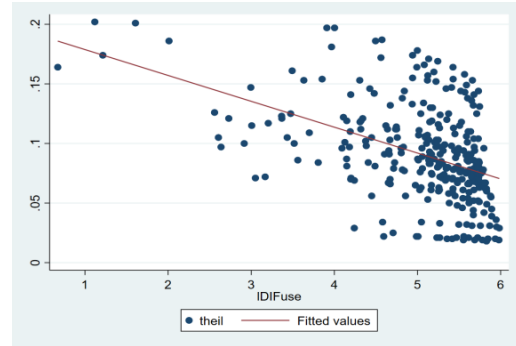


图 1 (b)

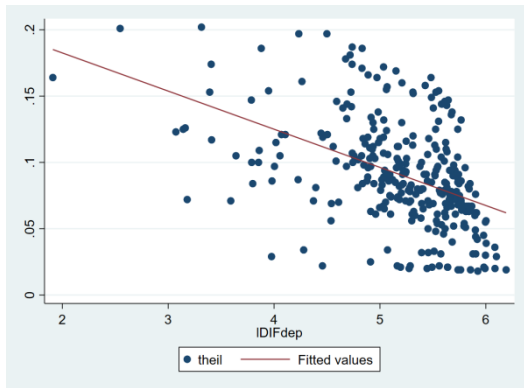


图 1 (c)

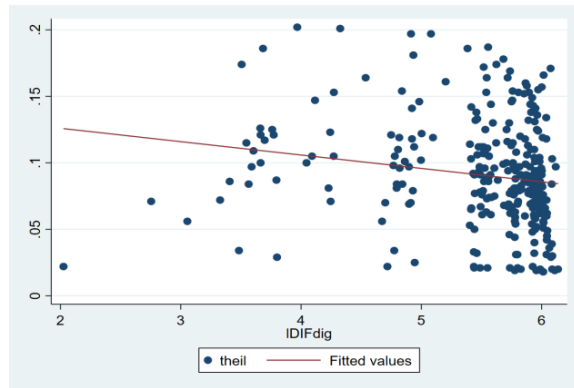


图 1 (d)

Figure 1 Fitting scatter trend of digital inclusive finance and its sub-dimensional indices affecting the urban-rural income gap

IV Empirical Results and Analysis

(i) Baseline regression estimation results

In order to ensure the scientific nature of the model regression results, the econometric theory of short panel model selection and testing is combined¹, focusing on the cross-sectional correlation, heteroskedasticity, and autocorrelation problems that may exist in the error

1 for PLS and FE models: because the short panel data is a balanced panel and time effects are considered, the value of the test presence cross-sectional correlation statistic is 8.80, which is greater than the critical value of 0.5198 at 1% significance level, rejecting the original hypothesis that the model does not have cross-sectional correlation; after dealing with the cross-sectional correlation The p-value of the F-statistic for the model selection under the premise of the problem of cross-sectional correlation is 0, so the FE model is selected. For the PLS and RE models: the p-value of the model selection statistic for is 0, the original hypothesis is rejected, and the FE is selected. for the FE and RE models, the p-value of the hausman test statistic corresponding to is 0 under the premise of considering cross-sectional correlation, and the FE is selected.

term in the short panel model¹, the model was finally determined to use the panel two-way fixed effects model. Table 3 reports the regression results of the fixed effects of equations (1)-(4). From model (1)-model (4), it can be found that: the effects of digital inclusive finance on urban-rural income gap are both significantly negative at 1% significance level, and hypothesis 1 is verified; and the effects of breadth of coverage and depth of use of digital inclusive finance on urban-rural income gap are

negative at 1% significance level, and hypotheses 2 and 3 are verified; the effects of digitization of digital inclusive finance are positive at 1% significance level Hypothesis 4 is verified. The coefficients of other control variables are significantly negative, except for the coefficients of traditional financial development and financial support to agriculture, which are not significant, in line with theoretical expectations.

Table 3 Regression results of the model

	Model(1)	Model(2)	Model(3)	Model(4)
<i>ln DIF</i>	-0.005** (0.002)			
<i>ln(DIFuse)</i>		-0.003*** (0.001)		
<i>ln(DIFdep)</i>			-0.007*** (0.001)	
<i>ln(DIFdig)</i>				0.007*** (0.002)
<i>Lgdp</i>	-0.038*** (0.005)	-0.034*** (0.006)	-0.040*** (0.004)	-0.043*** (0.004)
<i>urban</i>	-0.246*** (0.016)	-0.238*** (0.014)	-0.236*** (0.012)	-0.238*** (0.017)
<i>is</i>	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
<i>fd</i>	0.074 (0.070)	0.077 (0.070)	0.106 (0.065)	0.077 (0.062)
<i>afe</i>	-0.001 (0.060)	0.009 (0.057)	0.021 (0.061)	0.010 (0.052)
<i>edu</i>	-0.001** (0.000)	-0.001** (0.000)	-0.003** (0.000)	-0.005** (0.000)
<i>N</i>	310	310	310	310
<i>R2</i>	0.927	0.929	0.931	0.932

(ii) Endogenous problems

Considering that digital inclusion finance affects the urban-rural income gap is a relatively macro-level problem, effectively identifying the endogeneity problems existing in the model and stripping out the unidirectional effect of digital inclusion finance on the urban-rural income gap is the key to the empirical evidence of the article. To this end, each of the three possible endogeneity problems in the model regressions will be discussed.

Second, the problem of measurement error: The digital

inclusive financial index adopts a combination of subjective and objective empowerment to determine the weight in the measurement process, which is well suited to the development of digital inclusive finance in

reality and has high robustness. The income gap between urban and rural areas was measured by the Thiel index, which effectively ensured the objectivity and accuracy of weight assignment. In addition, after comparing the index measured in this paper with the results measured by other scholars, it is found that the general trend is basically consistent, which further ensures the reliability of the index measurement results. Accordingly, the measurement error is negligible.

Third, the problem of missing variables: considering that there may be factors in equation (1) that affect both digital financial inclusion and urban-rural income disparities, such as a series of unobservable factors such as personal ability, consumer preferences, and future expectations, this will lead to bias in the model regression coefficient. In order to further avoid the endogenous problem of the above problems, this paper constructs a “Bartik instrument”

(the product of the lagging first-order digital financial inclusion index and the first-order difference of the digital inclusive financial index) to perform instrumental variable regression. The results of the under-identification test of instrumental variables (LM statistic of 114.34, corresponding to p-value of 0) and the weak instrumental variable test (Wald F statistic of 206,153) show that the above instrumental variables are valid. The two-stage least squares method was used for regression testing. The specific regression results are shown in Table 4. In the first stage, the coefficient of regression results is significantly not equal to 0. From the second stage regression results, the development of digital inclusive finance narrows the income gap between urban and rural areas, which further demonstrates the reliability of the regression of the model in this paper.

Table 4 Regression results of instrumental variables

	Stage 1 (Dependent variable $\ln(DIF)$)	Stage 2 (Dependent variable $theil$)
$\ln(DIF)$		-0.017*** (0.003)
Tool Variables (L.DIF*D.DIF)	-0.138*** (0.010)	
Control variables	YES	YES
Time Effect	YES	YES
Individual effects	YES	YES
N	570	570
R^2	0.9473	0.5096

(iii) Robustness test
Considering the special status of four municipalities (Beijing, Shanghai, Tianjin and Chongqing) in China, in order to further verify the robustness of the regression results in this paper, four municipalities in the sample

were excluded. The specific regression is shown in Table 5, and the coefficients of the regression results of the model (1)-(4) are significantly negative at the 5% level, which further ensures the reliability of the conclusions in this paper.

Table 5 Exclusion of municipalities regression results

	Model(1)	Model(2)	Model(3)	Model(4)
$\ln DIF$	-0.006** (0.002)			
$\ln(DIFuse)$		-0.003*** (0.001)		
$\ln(DIFdep)$			-0.008*** (0.001)	

$\ln(DIFdig)$				0.011*** (0.003)
<i>Lgdp</i>	-0.042*** (0.005)	-0.038*** (0.006)	-0.044*** (0.004)	-0.047*** (0.004)
<i>urban</i>	-0.223*** (0.029)	-0.215*** (0.026)	-0.218*** (0.025)	-0.230*** (0.029)
<i>is</i>	-0.001*** (0.000)	-0.001*** (0.000)	-0.001** (0.000)	-0.001* (0.000)
<i>fd</i>	0.065 (0.083)	0.066 (0.082)	0.102 (0.080)	0.094 (0.078)
<i>afe</i>	-0.002 (0.056)	0.007 (0.053)	0.020 (0.058)	0.019 (0.045)
<i>edu</i>	-0.000* (0.000)	-0.000* (0.000)	-0.000** (0.000)	-0.000* (0.000)
<i>N</i>	270	270	270	270
<i>R2</i>	0.927	0.929	0.931	0.936

(iv) Analysis of regional heterogeneity

In order to further investigate whether there is regional heterogeneity in the impact of digital financial inclusion on urban-rural income gap, this paper further divides the sample into three sub-samples for regression: eastern, central and western. This is shown in Table 6. According to the regression results, the urban-rural income gap between

urban and rural areas in the eastern region is negative under the significance level of 1%, but it is not significant in the central and western regions, which indicates that the current development of digital inclusive finance is conducive to narrowing the urban-rural income gap in the developed regions of eastern China.

Table 6 Regional heterogeneity analysis of digital financial inclusion as independent variables

	Model(1)	Model(2)	Model(3)
$\ln DIF$	-0.008*** (0.002)	0.005 (0.006)	-0.004 (0.003)
Control variables	YES	YES	YES
Time Effect	YES	YES	YES
Individual effects	YES	YES	YES
<i>N</i>	110	80	150
<i>R2</i>	0.969	0.983	0.946

Table 7 shows the regional heterogeneity results of the impact of the three dimensions of digital financial inclusion on the income gap between urban and rural areas. According to the regression results, the models (1)-(3) correspond to the regression results of the breadth of digital inclusive financial coverage to the urban-rural income gap in the eastern, central and western regions, respectively, and the results show that the breadth of digital financial coverage narrows the urban-rural

income gap in the eastern and western regions, while the breadth of digital financial coverage widens the urban-rural income gap in the central region. The models (4)-(6) correspond to the regression results of the depth of use of digital inclusive finance on the urban-rural income gap in the eastern, central and western regions, respectively, and the results show that the depth of use of digital finance narrows the urban-rural income gap in all regions, and the effect of the eastern region is stronger.

The models (7)-(9) correspond to the regression results of the digitalization degree of digital inclusive finance to the urban-rural income gap in the eastern, central and western regions, respectively, and the results show that the current

digitalization degree of digital finance widens the urban-rural income gap in all regions, and the western region has the strongest effect.

Table 7 The independent variables are the regional heterogeneity of the digital inclusion index by dimension

	ln(DIFuse)			ln(DIFdep)			ln(DIFdig)		
	Model(1)	Mode(2)	Mode(3)	Mode(4)	Mode(5)	Mode(6)	Mode(7)	Mode(8)	Mode(9)
IDIFuse	-0.005*** (0.001)	0.005*** (0.001)	-0.002** (0.001)						
IDIFdep				-0.008** (0.002)	-0.005*** (0.001)	-0.006** (0.002)			
IDIFdig							0.003*** (0.001)	0.004* (0.002)	0.010** (0.004)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Individual effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	110	80	150	110	80	150	110	80	150
R2	0.969	0.984	0.946	0.969	0.985	0.948	0.970	0.984	0.950

V Conclusions and Enlightenment

This paper uses the balance panel data of 31 provinces in China from 2011 to 2020, and uses the panel fixed effect model empirical test to obtain the following results: first, the development of digital inclusive finance has narrowed the income gap between urban and rural areas in China, and the above conclusions are still valid after using instrumental variable regression and a series of robustness tests; Moreover, the breadth and depth of digital financial inclusion narrows the income gap between urban and rural areas; The digitalization of digital financial inclusion has widened the income gap between urban and rural areas. Second, the impact of digital financial inclusion and its sub-dimensional index on urban-rural income disparity is heterogeneous. Specifically, the development of digital financial inclusion has narrowed the income gap between urban and rural areas in the eastern region of China, and the impact on the central and western regions is not significant. The breadth of digital finance has narrowed the urban-rural income gap between the eastern and western regions, while the breadth of digital financial coverage has widened the urban-rural income gap in the central region. The depth of use of digital finance has narrowed

the income gap between urban and rural areas in all regions, and the effect of the eastern region is stronger. At present, the degree of digitalization of digital finance has widened the income gap between urban and rural areas in all regions, and the western region has the strongest effect. According to the research results of this paper, the following enlightenment is obtained: First, encourage the development of digital inclusive finance, continuously expand its coverage and depth of use, and narrow the income gap between urban and rural areas in China. In addition, with the cross-integration of digital technology and finance, the boundaries of financial services are increasingly blurred, and the characteristics of financial risks are constantly amplifying, the government needs to further strengthen the professionalism, unity and penetration of financial supervision, actively explore and promote the digital financial supervision sandbox mechanism, balance financial risks and innovation, and correct the negative role of financial digitalization in widening the income gap between urban and rural areas. Secondly, considering the regional heterogeneity of digital inclusive finance and its sub-dimensional index to the urban-rural income gap, pay attention to the positive role

of the development of digital inclusive finance and its sub-dimensional index in narrowing the urban-rural income gap in various regions of China, and be highly vigilant against the negative impact of insufficient and unbalanced digital financial development in sectoral regions and widening the urban-rural income gap.

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