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Digital Inclusive Finance and Residents' Consumption Level: Analysis Based on Mediating Effect Test

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Abstract: *Digital inclusive finance has the advantages of both the digitalization of inclusive finance and the inclusion of digital finance, which can stimulate residents to break through the temporal and spatial limitations of consumption and release their consumption potential. Based on the panel data of 31 provinces and cities in China from 2014 to 2020, this paper analyzes the relationship between digital inclusive finance and residents' consumption level, explores the mediating mechanism of the effect, and conducts heterogeneity test. The conclusion shows that digital inclusive finance can significantly promote the improvement of residents' consumption level through the mediating mechanism of increasing residents' income, facilitating payment and optimizing industrial structure, and the effect is more obvious in the eastern coastal regions and non-complex terrain regions. Finally, the corresponding suggestions are put forward based on the conclusions. We should promote the construction of communication infrastructure, increase residents' incomes through tax policies, preferential subsidies and other means. Furthermore, we need to leverage synergies to upgrade the industrial structure and strengthen the popularization of financial knowledge, so as to accelerate the expansion of domestic demand.*

Keywords: *Digital inclusive finance, Residents' consumption level, Mediating mechanism*

1. Introduction and literature review

In recent years, affected by the COVID-19 pandemic, the Russia-Ukraine conflict and other events, China has proposed to speed up efforts to foster a new development paradigm with domestic circulation as the mainstay and domestic and international circulations reinforcing each other, emphasizing the expansion of domestic demand and driving the sustained growth of the Chinese economy. Data show that in 2021, China's residents' consumption rate was 38%, far lower than the world's average consumption rate of 54% in the same period. Consumer spending, with a contribution rate of 46%, ranked first as the driving force of economic growth, indicating that residents' consumption has made a huge contribution to China's economic growth, but there is still a large room for improvement. At present, one of the priorities of China's economic development is still to stimulate the potential of residents' consumption and expand domestic demand.

The concept of inclusive finance first appeared in the promotion of the United Nations International Year of Microcredit in 2005. At the G20 Hangzhou Summit in September 2016, China promoted the formulation of the G20 High-level Principles for Digital Financial Inclusion, emphasizing that digital inclusive finance is a new form of financial services that uses digital technology to promote inclusive finance to cover more people around the world. It focuses on low-income urban people, rural people, people in remote areas and other special groups, as well as small and micro enterprises, which are not covered by the existing financial system. From the perspective of inclusion, digital inclusive finance is a powerful supplement to traditional finance with low cost, wide coverage and deep service. It can inspire residents to break through the time and space limitations of traditional finance, obtain payment, credit, insurance, investment and other services at an affordable cost, and release consumption potential.

Existing researches mostly focuses on the direct impact of digital inclusive finance on residents' consumption level, mainly from micro and macro perspectives. Many studies are based on household survey data in China, CHEN et al. (2022)[1] shows that digital inclusive finance can promote the improvement of household consumption level of Chinese residents, and YI et al. (2018)[2] determined that the effect was stronger for basic living consumption. LONG et al. (2022)[3] realized that this effect had heterogeneous differences among families with different income and different educational background through further research. The research conclusions based on macro statistical data are similar. ZHOU et al. (2022)[4] show that the development of digital inclusive finance can improve the consumption level of residents in different regions of China. Furthermore, CUI (2017)[5] and TANG et al. (2021) [6] verify a more detailed conclusion that this effect is more obvious in the western region, rural areas and economically underdeveloped areas. At the same time, REN et al. (2022) [7] found that the two business dimensions of digital inclusive finance, breadth coverage and usage depth, can significantly improve household consumption expenditure. LAN et al. (2021) [8] confirmed that the development of digital inclusive finance in China and residents' consumption show a significant positive spatial spillover effect. Some scholars have studied the mediating mechanism of digital inclusive finance affecting residents' consumption level, and NAN et al. (2020) [9] found that digital inclusive finance mainly promotes household consumption through digital payment, credit and monetary funds.

The existing literature has made useful exploration on the relationship between digital inclusive finance and the consumption level of Chinese residents, among which some scholars have studied the mechanism of digital inclusive finance affecting the consumption level of Chinese residents from a micro perspective. However, there is a lack of research from a macro perspective and heterogeneity test based on the complexity of terrain. Based on this, this paper uses macro panel data as samples to test the relationship between digital inclusive finance and residents' consumption level, and to clarify the influencing mechanism of digital inclusive finance to promote residents' consumption, which is of great significance to give full play to the consumption expansion effect of digital inclusive finance in the future. At the same time, this paper conducts heterogeneity test to judge the regional differences in the impact of digital inclusive finance on residents' consumption, so as to deepen the research in this field. Under the new dual-circulation development pattern, it is of great significance to study the relationship between digital inclusive finance and improving residents' consumption level for accelerating the transformation of China's economic development mode.

2. Theoretical analysis and research hypotheses

As a new form of financial services, digital inclusive finance has the advantages of both the digitalization of inclusive finance and the inclusion of digital finance. On the one hand, the inclusion of digital finance is committed to providing effective, convenient and all-round financial services for all sectors of society on the basis of applying the original information technology to financial services, focusing on groups that are difficult to receive financial services, such as residents with small savings and low education level. Under the advocacy of the Chinese government, financial institutions have developed personalized and diversified financial products for special groups, such as loans for self-employed entrepreneurs and farmers, to bring convenience to their life, production and operation, break the information cocoon room caused by the original financial institutions' services due to individual differences, and improve the coverage radius of financial services. On the other hand, the digitalization of inclusive finance is the use of mobile Internet, big data, cloud computing and other technologies, which can not only facilitate financial institutions to supervise residents' credit situation in real time and control their own credit risks, but also lower the threshold for residents to obtain financial services and improve the frequency of the demand side to use financial services, so that more and more people can invest, borrow and consume at low cost without leaving their homes. Based on the above analysis, a hypothesis is proposed:

Hypothesis 1: Digital inclusive finance can improve the consumption level of residents.

According to the Absolute income Hypothesis, the current absolute income determines household consumption, and the increase of income level can meet more potential consumption demand, thus expanding the total consumption. The development of digital inclusive finance is conducive to the improvement of residents' income level. First of all, digital inclusive finance can provide convenient investment services, make it possible for residents to manage their wealth anytime and anywhere, and at the same time provide diversified financial products to lower the investment threshold, breaking the traditional concept that financial management is an exclusive service for high net worth customers, so that more ordinary residents have the opportunity to obtain additional financial income. Secondly, digital inclusive finance can make full use of the comprehensive credit system to provide efficient and convenient lending services for small and micro business operators, so that they can quickly obtain financial support and solve the problem of insufficient funds in life, production and operation. Meanwhile, the interest rate of inclusive finance is lower and the repayment period is longer, which further reduces the borrowing cost. It is conducive to the long-term development of self-employed and small-scale private businesses, thus improving the overall income level. Finally, digital inclusive finance can enable residents to obtain compensation funds when accidents occur through insurance, such as diseases and traffic accidents, so as to help residents avoid financial losses caused by possible unexpected accidents. Based on the above analysis, a hypothesis is proposed:

Hypothesis 2: Digital inclusive finance can improve the residents' consumption level by increasing residents' income.

One of the key points of digital inclusive finance is inclusive, which relies on the development of mobile Internet to make payment behavior break the limitation of time and space. Through the popularization of digital payment methods such as NFC and face recognition, the convenience of payment can be improved, so as to improve residents' consumption experience and stimulate their consumption potential, thus helping to improve the level of consumption. At the same time, consumer loans such as Ant Credit Pay, which are quick to review and easy to use, have also eased residents' liquidity constraints to some extent, stimulated residents' consumer demand and improved the overall consumption level. Based on the above analysis, a hypothesis is proposed:

Hypothesis 3: Digital inclusive finance can improve the residents' consumption level by facilitating payment.

Digital inclusive finance uses big data to build a perfect credit system, enabling small and micro business operators to obtain low-cost and efficient loans, and solving financing problems. Sufficient financial support is conducive to enterprises' technological innovation and industrial structure optimization. Financial institutions can save the human and material resources of pre-loan approval and improve the efficiency of capital allocation. In the meantime, financial institutions can monitor risks in real time and lend funds with the largest marginal utility according to the financial situation of enterprises, so as to realize the rational allocation of credit funds in the whole society and effectively promote the optimization of the overall industrial structure. The upgrading of industrial structure can provide products or services with higher value-added, and help to release the consumer demand of Chinese residents which is suppressed due to the supply gap of high-end products. Meanwhile, the competitiveness of enterprises continues to improve, and with the improvement of economic benefits, the treatment of employees increases, which can also improve the consumption level. Based on the above analysis, a hypothesis is proposed:

Hypothesis 4: Digital inclusive finance can improve the residents' consumption level by optimizing the industrial structure.

3. Study design

3.1 Model construction

In order to analyze the direct impact of digital inclusive finance on the consumption level of Chinese residents, this paper constructs the benchmark regression Model 1, the model is as follows in Equation (1):

$$\mathrm{Lncon}_{i,t} = \alpha + \beta \mathrm{Lndfi}_{i,t} + \gamma X_i + \varepsilon_{i,t} \tag{1}$$

In Equation (1), $\mathrm{Lncon}_{i,t}$ represents the consumption level of Chinese residents' in the i province of the t year, and $\mathrm{Lndfi}_{i,t}$ represents the level of digital inclusive finance in the i province of the t year. The impact coefficients β describes the effect of digital inclusive finance on the level of residents' consumption. X represents the set of all control variables, α denotes the intercept term, and the coefficients to be estimated are β and γ, $\varepsilon_{i,t}$ is the random disturbance term. In order to control the impact of other macro factors on the level of residents' consumption, the provincial fixed effect is added to Equation (1), and i represents the province. This paper should focus on the plus or minus sign of β, if β is positive, it indicates that digital inclusive finance can improve the consumption level of Chinese residents.

3.2 Data sources

This paper takes 31 provinces and cities in China (excluding Hong Kong, Macao and Taiwan) as samples from 2014 to 2020. The data are from the China Digital Financial Inclusion Index compiled by the research team from the Institute of Digital Finance at Peking University and Research Institute at

Ant Group. The other data needed for the studies come from the China Statistical Yearbook over the years.

3.3 Variable descriptions

3.3.1 Explained variable

Referring to the paper of ZOU et al. (2020) [10], residents' consumption level (Lncon) is measured by per capita consumption expenditure, and the index is introduced into the econometric model after taking the logarithm.

3.3.2 Explanatory variables

Referring to the method of ZHANG et al. (2019) [11], the development level of digital inclusive finance (Lndfi) is measured by the Peking University Digital Financial Inclusion Index[12], which is composed of three first-level dimensions: coverage breadth (D1), usage depth (D2) and digitalization level (D3). Among then, coverage breadth mainly examines account coverage rate, usage depth represents the use of six types of business including payment, monetary fund, credit, insurance, investment and credit investigation, and digitalization level is divided into four sub-dimensions: mobility, affordability, credibility and facilitation. All indicators were introduced into the model after taking the logarithm.

3.3.3 Intermediary variables

Referring to the way of JIANG et al. (2020) [13], income level (Lninc) is measured by residents' per capita disposable income, payment facilitation (Lnpay) is measured by the payment business index of China Digital Financial Inclusion Index, and industrial structure (Indu3) is measured by the ratio of the added value of the tertiary industry to the added value of the secondary industry. Among them, the income level and payment facilitation are introduced into the study after taking the logarithm.

3.3.4 Control variables

In addition to the above main variables, there are still other factors that will have a certain impact, so the following control variables are set. Economic development level (Lngdp) is measured by per capita GDP, urbanization level (Urben) is measured by the ratio of urban population to total population, elderly dependency ratio (Osr) is measured by the ratio of population over 65 years old to labor force population, and government behavior (Lngov) is measured by fiscal expenditure. Among them, the economic development level and government behavior are need to take the logarithm.

3.4 Descriptive statistics

Table 1: Variable descriptive statistical analysis.

Variable	Observation	Mean	Standard deviation	Min	Max
Lncon	217	9.758	0.336	8.898	10.728
Lndfi	217	5.559	0.237	4.969	6.068
Lngdp	217	10.895	0.415	10.135	12.013
Urben	217	0.592	0.126	0.252	0.942
Osr	217	15.32	3.837	7	25.48
Lngov	217	8.48	0.581	6.908	9.766

From 2014 to 2020, the consumption level of Chinese residents was significantly different, with the minimum value of 8.898 and the maximum value of 10.728 after taking the logarithm. The development level (logarithm) of digital inclusive finance in different regions also showed significant differences, with the maximum value being 6.068 and the minimum value being 4.969. Among the control variables, the economic development level (logarithm), urbanization level, elderly dependency ratio and government behavior (logarithm) also have great differences.

4. Empirical analysis and testing

4.1 Benchmark regression

According to the results of LM test and Hausman test, this paper selects the fixed effect model for benchmark regression. Column (1) in Table 2 shows the regression results without control variables, Column (5) shows the regression results with all control variables, and Column (2)-(4) present the

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regression results with control variables added sequentially.

Table 2: Results of benchmark regression.

	(1)	(2)	(3)	(4)	(5)
Variable	Lncon	Lncon	Lncon	Lncon	Lncon
Lndfi	0.645***	0.371***	0.296***	0.323***	0.253***
	(0.013)	(0.042)	(0.044)	(0.044)	(0.046)
Lngdp		0.402***	0.329***	0.339***	0.298***
		(0.058)	(0.059)	(0.058)	(0.057)
Urben			1.034***	1.069***	0.906***
			(0.255)	(0.251)	(0.245)
Osr				-0.005***	-0.006***
				(0.002)	(0.002)
Lngov					0.173***
					(0.044)
Cons	6.170***	3.319***	3.910***	3.702***	3.186***
	(0.070)	(0.419)	(0.428)	(0.428)	(0.432)
Observation	217	217	217	217	217
R^2	0.935	0.948	0.953	0.954	0.958
Province	Yes	Yes	Yes	Yes	Yes
Note: Symbols *, **, and *** indicate statistical significance at 10%, 5% and 1% levels, respectively. Standard errors are in parentheses. The same is below.					

From Table 1, no matter whether control variables are added or not, the estimated coefficients of digital inclusive finance index are all positive and significant at the level of 1%, indicating that the development of digital inclusive finance can promote the improvement of residents' consumption level. After the control variables are added successively, the explanatory power of the model is gradually improved. The estimated coefficients of economic development level, urbanization level and government behavior are significantly positive, indicating that economic development promotes the increase of residents' consumption, and the higher urbanization rate and the increase in government fiscal expenditure are conducive to improving the consumption level of residents. The estimated coefficient of the elderly dependency ratio is significantly negative, indicating that population aging reduces the consumption level.

4.2 Robustness test

Table 3: Results of robustness test.

	(1)	(2)	(3)	(4)
Variable	Lncon	Lncon	Lncon	Lncon
Lnd1	0.449***			
	(0.050)			
Lnd2		0.113***		
		(0.023)		
Lnd3			0.019	
			(0.022)	
L.lndfi				0.286***
				(0.050)
Lngdp	0.094	0.374***	0.503***	0.267***
	(0.060)	(0.052)	(0.048)	(0.066)
Urben	-0.017	0.586***	0.792***	0.103
	(0.157)	(0.153)	(0.157)	(0.167)
Osr	-0.007***	-0.005**	-0.005**	-0.008***
	(0.002)	(0.002)	(0.002)	(0.002)
Lngov	0.220***	0.287***	0.314***	0.273***
	(0.040)	(0.044)	(0.049)	(0.057)
Cons	4.532***	2.358***	1.118***	3.048***
	(0.457)	(0.388)	(0.314)	(0.485)
Observation	217	217	217	186
R^2	0.960	0.949	0.943	0.942
Province	Yes	Yes	Yes	Yes

The development of digital inclusive finance can improve the residents' consumption level, but the improvement of consumption level will also stimulate economic growth, and the continuous improvement of social infrastructure construction. The development level of digital inclusive finance

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increases with these two, so there may be bidirectional causality. In this paper, two methods are used to conduct robustness test. The first is to replace the explanatory variables with three sub-indexes: coverage breadth (Lnd1), usage depth (Lnd2) and digitalization level (Lnd3), and the second is to add the explanatory variables lagged by one period into the model 1.

From columns (1)- (3) of Table 3, it can be seen that at the 1% significant level, both the coverage breadth and the usage depth of digital inclusive finance have a significant role in promoting the consumption level of residents. The digitalization level has no significant impact on residents' consumption level, possibly because the affordability in the digitalization level is measured by the average loan interest rate, and the credibility is measured by the frequency and amount proportion of using Ant Credit Pay and Deposit-free Sesame Credit payments. The higher the digitalization level is, the lower the loan interest will be, and the higher the frequency and amount proportion of using Ant Credit Pay and Deposit-free Sesame Credit payments will be. The two effects offset each other, resulting in an insignificant impact of digitalization level on consumption level.

According to Column (4) of Table 3, at the significant level of 1%, the Digital Financial Inclusion Index lagged by one period still has a significantly positive promotion effect on residents' consumption level.

4.3 Mediating effect test

In order to investigate the mechanism through which digital inclusive finance affects residents' consumption level, Models 2 are constructed according to the testing procedure of mediating effect. The Model 2 is as follows in Equation (2) and Equation (3):

$$\mathrm{Inter}_{i,t} = \alpha_1 + \beta_1 \mathrm{Lndfi}_{i,t} + \gamma_1 X_i + \varepsilon_{i,t} \tag{2}$$

$$\mathrm{Lncon}_{i,t} = \alpha_2 + \pi \mathrm{Inter}_{i,t} + \beta_2 \mathrm{Lndfi}_{i,t} + \gamma_2 X_i + \varepsilon_{i,t} \tag{3}$$

Equation (2) is used to test the relationship between intermediary variables and the development level of digital inclusive finance, and Equation (3) adds intermediary variables and residents' consumption level into the Model 1 at the same time. The mediating effect is judged by the significance of β_1 in Equation (2) and π in Equation (3). If both are significant, the significance of β_2 in Equation (3) is tested to further determine whether it is a complete mediating effect. If at least one of the two is not significant, the Sobel test is performed.

In order to determine the intermediary role of residents' income, payment facilitation and industrial structure in the process of improving residents' consumption level by the development of digital inclusive finance, Equation (2) and Equation (3) are used for regression respectively.

Table 4: Results of mediating effect test.

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Lninc	Lncon	Lnpay	Lncon	Indu3	Lncon
Lndfi	0.313***	0.112**	1.178***	0.223***	0.779***	0.279***
	(0.028)	(0.056)	(0.105)	(0.060)	(0.145)	(0.050)
Lninc		0.635***				
		(0.113)				
Lnpay				0.075**		
				(0.032)		
Indu3						0.041*
						(0.024)
Lngdp	0.418***	0.022	-0.386***	0.315***	-0.735***	0.317***
	(0.032)	(0.068)	(0.120)	(0.054)	(0.165)	(0.055)
Urben	0.737***	-0.047	-0.348	0.447***	-1.073**	0.465***
	(0.091)	(0.162)	(0.339)	(0.149)	(0.469)	(0.151)
Osr	0.002*	-0.008***	-0.009**	-0.006***	0.026***	-0.007***
	(0.001)	(0.002)	(0.004)	(0.002)	(0.006)	(0.002)
Lngov	0.062**	0.157***	0.275***	0.176***	0.349**	0.182***
	(0.028)	(0.042)	(0.102)	(0.046)	(0.141)	(0.046)
Cons	2.811***	1.309***	1.093	3.011***	2.396*	2.993***
	(0.246)	(0.490)	(0.914)	(0.401)	(1.263)	(0.406)
Observation	217	217	217	217	217	217
R^2	0.987	0.961	0.906	0.955	0.676	0.955
Province	Yes	Yes	Yes	Yes	Yes	Yes

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It can be seen from Columns (1) and (2) of Table 4 that the development of digital inclusive finance can increase the disposable income of residents, and thus promote the increase of total consumption of residents. Hypothesis 2 is established. From columns (3) and (4), the development of digital inclusive finance can make payment more convenient, improve consumption experience, and thus stimulate residents' consumption. Hypothesis 3 is confirmed. As shown in Columns (5) and (6), the development of digital inclusive finance can also accelerate the upgrading of industrial structure and further improve the level of residents' consumption, so Hypothesis 4 is verified.

4.4 Heterogeneity test

Due to China's large land area and large population, the economic development level and other influencing factors vary greatly among different regions, and the unbalanced regional development is the current economic situation. There may be regional differences in the impact of digital inclusive finance on residents' consumption level, so the heterogeneity test is conducted. According to the geographical location, it can be divided into the eastern coastal regions and the central and western inland regions, and according to the terrain complexity, it can be divided into the complicated terrain regions and other regions. Then, group-based regression analysis was performed on the sample.

Table 5: Results of heterogeneity test.

	(1) Eastern regions	(2) Central & western regions	(3) complicated terrain regions	(4) Other regions
Variable	Lncon	Lncon	Lncon	Lncon
Lndfi	0.478^{***}	0.211^{***}	0.160^{**}	0.387^{***}
	(0.099)	(0.059)	(0.070)	(0.066)
Lngdp	0.073	0.288^{***}	0.332^{***}	0.297^{***}
	(0.127)	(0.060)	(0.070)	(0.087)
Urben	0.199	0.322	0.394^{*}	0.554^{**}
	(0.252)	(0.228)	(0.235)	(0.211)
Osr	-0.006^{*}	-0.007^{***}	-0.009^{***}	-0.008^{***}
	(0.003)	(0.002)	(0.003)	(0.003)
Lngov	0.146^{**}	0.374^{***}	0.366^{***}	0.100^{*}
	(0.060)	(0.077)	(0.077)	(0.058)
Cons	5.221^{***}	2.165^{***}	2.049^{***}	3.346^{***}
	(0.973)	(0.466)	(0.569)	(0.648)
Observation	77	140	112	105
R^2	0.936	0.966	0.960	0.953
Province	Yes	Yes	Yes	Yes

It can be seen from Table 5 that the estimated coefficients in the eastern coastal regions are greater than those in the central and western inland regions, and those in other regions are greater than those in the regions with complicated terrain, indicating that the role of digital inclusive finance in improving the consumption level of Chinese residents in the central and western inland regions and the regions with complicated terrain is relatively small. Possible reasons for this problem are as follows: Inland regions and complicated terrain regions are subject to the influence of location and topography, the development level of traditional finance is relatively low, the financial literacy of residents is lacking, the popularization of digital inclusive finance is limited, and the impact on residents' consumption is small. The consumption potential of Chinese residents in inland regions and regions with complicated terrain has not been fully met.

5. Conclusions and suggestions

The study finds that the development of digital inclusive finance has a significant impact on promoting the improvement of residents' consumption level. From the influence mechanism, the development of digital inclusive finance can improve the consumption of Chinese residents by increasing their income, facilitating payment and optimizing the industrial structure. However, the effect of digital inclusive finance on the improvement of residents' consumption level in China's inland regions and regions with complex topography is weak.

In order to give full play to the role of digital inclusive finance in improving the consumption level of Chinese residents, this paper puts forward some suggestions as follows:

First, we should promote the construction of communication infrastructure and speed up the

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popularization of mobile payment technology.

Second, we need to increase people's incomes through tax policies, preferential subsidies and other means, especially for people in economically underdeveloped areas.

Third, we need to leverage synergies to upgrade the industrial structure in light of local conditions. Because the basic conditions of different regions are very different, we should first focus on the advantageous industries in each region to optimize the industrial structure.

Fourth, we should educate the general public more about financial knowledge. Inland regions in central and western China and regions with complex topography have a lower development level of digital inclusive finance. It is necessary to strengthen the popularization of financial knowledge, improve the acceptance of residents, break the constraint of low traditional financial development level, and accelerate the expansion of domestic demand.

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