

How Does Digital Finance Promote Household Consumption: An Analysis Based on Micro Survey Data

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The inexorable rise of digital finance has lead to huge changes in consumption patterns. Under this background, we match the index of Digital Financial Inclusion with data of the China Family Panel Studies (CFPS) to explore the relationship between digital finance and household consumption. Firstly, based on sub-sample empirical analysis, we find that digital finance has helped increase urban household consumption, especially the basic consumption related to life, in China. Secondly, we discuss the mechanism of digital finance to promote household consumption, concluding that the payment convenience of digital finance has accelerated household consumption decisions, thereby promoting consumption growth. Moreover, digital finance can also promote household consumption by reducing the uncertainty faced by family.

Keywords: digital finance development, household consumption, consumption structure, mechanism, urban-rural heterogeneity

1. Introduction

The development of digital economy in China can be described as changing with each passing day. Statistics show that, in 2019, China's online retail sales of physical goods reached 8523.9 billion yuan, an increase of 19.5% over the previous year, far higher than the 8.0% growth rate of the nation's total retail sales of social consumer goods in the whole year. Its share in the total retail sales of social consumer goods also reached 20.7%, 2.3 percentage points increase of the previous year. It is particularly worth noting that after the outbreak of COVID-19 in 2020, China's digital economy

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has performed brilliantly and responded first and most actively in the consumer market. It has played a stabilizing role in protecting and promoting consumption, effectively ensuring the effective operation of the national economy. According to the latest data of the National Bureau of Statistics, although the total retail sales of social consumer goods decreased by 16.2% from January to April 2020, the online retail sales of physical goods increased by 8.6% year-on-year, and its proportion in the total retail sales of social consumer goods further increased to 24.1%. It can be said that in the process of epidemic prevention and control, China's digital economy has once again confirmed its powerful role in protecting and promoting consumption.

Digital finance is not only an important support and guarantee of digital economy, but also an important part of it. In recent years, the high integration and deep penetration of digital finance and people's production and life are constantly strengthened, which greatly reduces the consumers' shopping cost, improves the consumption experience, creates a series of new consumption demands, and has an important impact on household consumption. For example, Alipay and WeChat payment have made many production, living and consumption behaviors more convenient. The time required for people to purchase and pay for their daily activities has changed from hours in the past to minutes or even seconds. More importantly, digital finance provides small and micro enterprises, farmers, low-income people in cities and towns, the poor, the disabled and the elderly and other special groups with the access to inclusive financial services, which plays an irreplaceable role in improving household budget constraints, reducing social transaction costs, promoting mass entrepreneurship, narrowing the income gap, thus greatly promotes household consumption.

It is pointed out in the report of the 19th National Congress of the Communist Party of China that China's economy has shifted from a stage of rapid growth to that of high-quality development in which consumption plays a fundamental role in economic growth. How to further release consumption potential and promote consumption upgrading through developing digital finance deserves our deliberate study. On February 10, 2020, while inspecting and guiding the pandemic prevention and control in Beijing, Xi Jinping, general secretary of the Communist Party of China called for efforts to coordinate the tasks of economic and social development, to ensure stability on six fronts; and to stabilize household consumption, develop online consumption, expand health consumption, and promote the smooth operation of the economy and society. To this end, it is pointed out in the government work report in 2020 that new business forms such as online shopping and online services played an important role in the fight against COVID-19 and our government would introduce more support policies to comprehensively promote the "Internet plus" and create a new advantage in digital economy.

In this context, it is of great significance to scientifically summarize the practical

experience of digital finance in promoting household consumption and to study the internal mechanism of digital finance affecting household consumption. This has important policy implications for the next stage of scientifically formulating the policy system of releasing consumption potential and promoting consumption upgrading by using digital finance.

In view of this, this paper attempts to empirically study the relationship between the development of digital finance and household consumption and its internal mechanism from the perspective of classical consumption theory, so as to provide quantitative reference for the development of digital finance promoting consumption growth in China.

This paper seeks to contribute in two areas:

First, this paper will explore the impact of digital finance development on household consumption from a more multidimensional perspective. It will not only study the overall impact of digital finance on urban and rural consumption, but also subdivide consumption into basic consumption and development-and-enjoyment-oriented consumption, and further study which kind of consumption in the family can be promoted by the development of digital finance. On this basis, it further tests and eliminates the possible mechanism of the development of digital Finance on household consumption behavior.

Second, to deal with the endogeneity that may exist in the model, this paper constructs instrumental variables based on the nodes formed in the “eight vertical and eight horizontal” optical cable trunk communication network. Compared with those constructed according to regional Internet penetration rate (Xie *et al.*, 2018) or lag term of digital financial index (Yi and Zhou, 2018), the instrumental variables selected in this paper are more exogenous.

2. Literature Review and Research Hypotheses

Digital finance has penetrated into all aspects of life, and the research on digital finance has gradually become a hot spot in the economic field. At present, the development mode of China’s digital finance is not mature, and it is in a period of rapid change. Its short-term impact and long-term impact on the real economy such as production, consumption, investment and employment are not clear, and need to be further tested. On the whole, the literature on the combination of digital finance development and consumption is still relatively limited.

The first strand of research focuses on the macro effect of consumption growth driven by digital finance development. Some researchers believe that digital finance development can help enterprises reduce the cost of production, circulation and transaction, improve the quantity and level of production, and then expand the breadth and depth of household consumption. Zhang and Tu (2017) pointed out that the

parallel development of digital finance and e-commerce has promoted the continuous expansion of consumption and service mode, also spawned a large number of demand for digital financial services, further stimulating the growth of consumer demand. Starting from the Internet consumption mode, Ma *et al.* (2017) empirically tested the promotion effect of Internet finance on household consumption behavior by building a dynamic GMM model. The study found that there are regional differences in this promotion effect, which is more conducive to the consumption growth of the eastern region.

The second strand of research focuses on the micro mechanism of the impact of digital finance development on consumption. Some researchers believe that the development of inclusive finance based on the Internet and digital technology has brought about changes in payment methods, greatly reducing costs of search, evaluation and transaction, and breaking through time and geographical constraints (Zeng and Reinartz, 2003; Jiao, 2014; Li, 2015; Zhou and Liang, 2018), which has led to changes in consumer behavior. At the same time, the emergence of digital inclusive finance has greatly expanded the scope of financial services, reduced the liquidity constraints, so that people who had been excluded from financial services can achieve cross period smoothing of consumption through financial services, and then release consumption demand (Campbell and Mankiw, 1991). Representative studies are made by Grossman and Tarazi (2014), who believe that the development of digital finance can promote household consumption by facilitating payment. In addition, providing savings and subsidies for families can also stimulate basic consumption demand, thus releasing consumption potential. Yi and Zhou (2018) theoretically explored the impact of the development of digital inclusive finance on household consumption, and empirically tested the internal mechanism of the development of digital inclusive finance to promote household consumption through two channels: easing liquidity constraints and improving payment convenience. The research by Fu and Huang (2018) found that the digital finance development increased the probability of rural consumer formal credit demand, among which the influence of highly educated groups and high-frequency online shopping groups was more obvious, indicating that digital finance has multiple effects of improving efficiency and promoting consumption.

On the whole, there is no consensus on how digital finance development promotes household consumption. The conclusions of different studies vary greatly, and there is a lack of elaboration and in-depth analysis on the internal mechanism of the two. At present, although a small amount of literature has discussed the micro mechanism of the impact of digital finance development on consumption, the research is limited to a specific theory or perspective.

In fact, consumption decision theory involves many hypotheses. Modigliani and Brumberg (1954) constructed a research framework of household consumption under

certain conditions, that is, life cycle hypothesis. It mainly studies the problem that a representative consumer tends to arrange consumption by allocating his whole life income under the constraint of intertemporal budget, so as to maximize the utility in the life cycle. Friedman (1957) further divides income into temporary income and permanent income, and points out that current consumption depends on permanent income. The precautionary saving hypothesis (Leland, 1968) further relaxed the hypothesis of certainty in the intertemporal optimal model, focusing on the impact of uncertainty on the consumption decision of micro subjects. According to the theory, under uncertain conditions, individuals will become more cautious in their consumption decisions, and individuals are more inclined to reduce their current consumption, and the resulting savings become preventive savings (Chamon *et al.*, 2010). The theory of liquidity constraint further breaks through the hypothesis of external environment in the intertemporal optimal model, and provides another possible explanation for the deviation of consumer behavior from deterministic conditions. Deaton (1991) found that individuals subject to budget constraints will have an incentive to increase savings. The lower the conversion ability of consumers in each period, the higher the prudent savings. A large number of studies have shown that the availability of financial services and the increase in the frequency of use can help ease the budget constraints faced by households, release liquidity, and optimize household consumption decisions (Karlan and Zinman, 2010).

To further clarify the internal mechanism of the impact of the development of digital Finance on consumer behavior, this paper puts forward the following four hypotheses based on the above theory, and intends to verify them one by one through empirical strategies and econometric methods, so as to better explain how the development of digital finance affects household consumption.

First, digital finance development has brought about changes in the method of payment, which has greatly facilitated the consumption; especially the emergence of Alipay and WeChat has enabled people to participate more in commercial activities and spend more. At the same time, the change of payment method also changes the way of commodity trading, promotes the offline commerce to online, further expands the scope of transaction, and enriches the consumer choices. Obviously, the higher the degree of participation in business activities caused by digital financial services, the higher the promotion effect on household consumption. Based on the above analysis, we propose Hypothesis 1.

Hypothesis 1: The convenience of digital payment has brought about the increase of payment frequency, accelerated the consumption decision-making, and then had a positive impact on household consumption.

Second, discussions are made based on the permanent income life cycle hypothesis. According to this hypothesis, people consume and save with the goal of maximizing the utility in the life cycle. The decision of current consumption depends on the

permanent income obtained by individuals. If digital finance brings about the growth of expected long-term income in the future, it can be expected that people will adjust their current consumption accordingly. Based on the above analysis, Hypothesis 2 is proposed.

Hypothesis 2: Digital finance development promotes consumption growth by affecting household disposable income.

Third, discussions are made based on the precautionary savings hypothesis. According to this hypothesis, individuals are more inclined to reduce consumption when facing uncertainty. As the core business of digital finance, digital insurance plays an important supporting role in dispersing risks and reducing the uncertainty of loss, which helps to improve the anti-risk ability of families, reduce the uncertainty of future cash flow of families, and promote the increase in consumption expenditure in the current period. Based on the above analysis, this paper proposes Hypothesis 3.

Hypothesis 3: Digital finance development reduces the uncertainty faced by families by providing services such as digital insurance, and then promotes the household consumption.

Fourth, analysis is made based on the theory of liquidity constraints. According to this theory, individuals who are constrained by budget will have the motivation to increase savings. The emergence of digital finance has greatly improved the financial means of ordinary people, provided the individuals who had been excluded from traditional finance with more access to financial services, further relaxed the budget constraints of families, and effectively released the suppressed consumption demand. Based on this, Hypothesis 4 is proposed.

Hypothesis 4: Digital finance development can relax the liquidity constraints of individuals through borrowing and other forms, so that individuals can follow the principle of utility maximization to improve consumption.

3. Research Design

3.1. Empirical Strategy and Variable Description

The benchmark model of this paper refers to the classical consumption theory proposed by Keynes. In this classical consumption theory, the higher the family income, the higher the level of household consumption. On this basis, this paper further introduces the indicators of digital finance development to examine its impact on consumer decision-making. c_{ijt} represents the total consumption expenditure of the household i in the region j , y_{ijt} represents the household income, and $Digital_{jt}$ represents the digital financial development degree of the region j in the period t . An extended consumption function model can be expressed as follows:

$$\ln c_{ijt} = \beta_0 + \beta_1 \ln y_{ijt} + \beta_2 \text{Digital}_{jt} + \xi' X_{ijt} + \theta_i + \delta_t + \mu_{ijt} \quad (1)$$

In model (1), the coefficient β_1 measures the effect of household income on total consumption, that is, marginal propensity to consume in the usual sense, and β_2 measures the effect of digital financial development. X_{ijt} represents a series of control variables that affect consumption. At the level of head of household, this paper controls the square of his/ her age (Zhang *et al.*, 2017), marital status (married = 1, otherwise 0), health status (health = 1, otherwise 0); at the family level, it further controls variables including the family size, child dependency ratio (children under 16 years as a proportion of the household labor force), old-age dependency ratio (persons aged 60 or over as a proportion of the household labor force), whether the family owns their own home (yes=1, otherwise 0), whether the family has private or bank loans (yes=1, otherwise 0); at the regional level, this paper includes variables such as the village/ community economic situation and the ratio of loan balance of financial institutions to regional GDP at the end of the year in the model to consider the effect of economic development and traditional financial deepening on household consumption.

In addition, c_{ijt} can also represent the itemized consumption expenditure of households. Generally, household consumption expenditure can be divided into eight categories: food, clothing, housing, household equipment and supplies, health care, transportation and communication, education, culture and entertainment, and other goods and services. Based on the practice of Luo and Zhang (2017), this paper further classifies food, clothing, housing and other goods and services as basic consumption, household equipment and supplies, medical care, transportation and communication as enjoyment consumption, and education, culture and entertainment as development consumption. Therefore, model (1) can be further used to examine the impact of digital finance development on the household consumption structure.

For model (1), this paper uses two-way fixed effect: θ_i represents the fixed effect at the family level to control the effect of household differences that do not change with time on consumption; δ_t represents the fixed effect of year to control the common time trend affecting household consumption; μ_{ijt} is a random disturbance term.

3.2. Estimation Method

Endogeneity problem may arise from the above model, which may lead to the error of estimation coefficient. One possibility is that the increase of household consumption may make the Internet more convenient and low-cost, thus promoting digital finance development. To overcome this problem, this paper uses instrumental variable estimation for model (1) to obtain consistent estimators of parameters and selects the “eight vertical and eight horizontal” optical cable trunk communication network nodes

built in 1998 to construct instrumental variables.

Generally, instrumental variables need to satisfy two preconditions of relevance and exclusivity. In terms of relevance, optical cable trunk transmission network is the most important material carrier of global information cycle, and the layout of information network infrastructure represents the spatial characteristics of Internet development. Therefore, we expect that the development level of digital finance in the node area of optical cable trunk transmission network will be higher, so as to meet the relevance conditions. In terms of exclusive constraints, the optical cable trunk transmission network was designed and laid in the 1990s. It is mainly built for communication reasons and relatively less affected by economic factors. It was built a long time ago and will have less impact on current consumption, thus meeting the exclusive constraints. In addition, considering that this instrumental variable does not change with time, this paper uses Zhang *et al.* (2019) for reference, interacts it with the average value of digital finance development in other regions of the country, and constructs a new instrumental variable that changes with region and time.

3.3. Data Introduction

In order to estimate model (1), the first part of the data used in this paper is from the China Family Panel Studies (CFPS) data released by the China Social Sciences Survey center of Peking University. The data cover 162 counties in 25 provinces, autonomous regions and municipalities directly under the central government, which is representative in China. This paper deals with the family data according to the common methods: (1) the unrecognized samples are deleted; (2) the head of household is identified by the householder and the financial respondent, and the head of household is defined as the representative individual of the family, and the age of the head of household is limited to over 16 years old.

The second part of the data is the development of digital finance at the regional level. This paper selects China's digital inclusive financial development index as the proxy variable of digital financial development. The index uses the big data of Ant Financial's trading account, jointly compiled by the Digital Finance Research Center of Peking University and Ant Financial Services Group (Guo *et al.*, 2020). The data are the annual data involving the three levels of province, city and county, widely recognized and applied to analyze digital finance development in China, and are highly representative and reliable.

The third part of the data is instrumental variable data, that is, the national "eight vertical and eight horizontal" optical cable communication trunk network nodes mentioned above, which are compiled according to the *Outline of the Ninth Five Year Plan of National Posts and Telecommunications* published in 1994 and relevant public information.

On this basis, this paper will match the above three parts of data according to the two dimensions of region and time, and finally select the sample interval of 2012, 2014 and 2016, and finally retain the sample families that entered the survey at the same time for three years.

Table 1. Statistical Description of Main Variables

Variables	2012			2016		
	Number of observations	Mean value	Standard deviation	Number of observations	Mean value	Standard deviation
Household consumption	5810	35598.560	44861.210	5810	48699.200	56755.340
Digital finance index	5810	89.373	17.240	5810	228.248	25.393
Household income	5810	36406.450	41136.120	5810	44268.280	47753.040
Age of head of household	5810	49.357	12.735	5810	53.385	12.722
Marital status of head of household	5810	0.892	0.311	5810	0.868	0.338
Health of head of household	5810	0.794	0.404	5810	0.811	0.391
Family size	5810	3.914	1.735	5810	3.801	1.823
Child dependency ratio	5810	0.146	0.164	5810	0.136	0.163
Old-age dependency ratio	5810	0.180	0.295	5810	0.243	0.332
Do the family own a house	5810	0.926	0.262	5810	0.910	0.286
Is there a private loan	5810	0.234	0.424	5810	0.245	0.430
Is there a bank loan	5810	0.066	0.248	5810	0.130	0.336
Degree of economic development	5810	4.530	1.162	5810	4.698	1.365
Financial deepening degree	5810	0.837	0.621	5810	1.170	0.604

4. Empirical Analysis

Next, this paper focuses on the relationship between digital finance development and household consumption. After the benchmark analysis of digital finance development and household consumption level, we discuss the endogeneity. Then, we focus on the relationship between digital finance development and consumer structure, and analyze the heterogeneity of urban and rural areas.

4.1. Digital Finance Development and Household Consumption Level

According to model (1), this paper examines the relationship between the digital finance development and the overall household consumption level. In all the regression analysis, we controlled the three types of control variables of household head

characteristics, household characteristics and economic characteristics of the region, as well as the double fixed effect of household and year. In addition, this paper will use the city-level robust clustering standard error.

First of all, we use the method of linear least squares regression to analyze the relationship between digital finance development and household consumption, as shown in column (1) of Table 2. The results are in agreement with expectations, that is, digital finance development is significantly positively related to household consumption, indicating that, on the whole, digital finance development promotes household consumption. The coefficients of other control variables are also roughly in line with expectations: The higher the head of household's self-assessment of health, the less households tend to spend on health. The variables at the household level can explain consumption well, among which, household income is significantly positively related to consumption, which is the main factor affecting consumption. Owning free housing will also reduce household living consumption to a certain extent. In addition, the availability of traditional financial loans can help to promote household consumption. It is worth mentioning that the coefficient of financial deepening degree is not significant, which means that the impact of digital financial development on household consumption cannot be replaced by traditional finance.

Table 2. Benchmark Analysis

Regression model	Benchmark regression	First-stage regression	Second-stage regression
Explained variables	Household consumption	Digital finance index	Household consumption
	(1)	(2)	(3)
Digital finance index	0.00374*** (0.00138)		0.01000* (0.00553)
Optical cable communication trunk node $\times$ average development of digital finance in other regions of China		0.0162*** (0.00460)	
Household income	0.0218*** (0.00379)	0.105 (0.0887)	0.0209*** (0.00369)
Square of the age of the head of household	-0.0303** (0.0141)	0.508* (0.285)	-0.0339** (0.0137)
Marital status of the head of household	0.0650 (0.0518)	-0.256 (0.551)	0.0673 (0.0522)
Health status of the head of household	-0.120** (0.0540)	-0.0368 (0.584)	-0.120** (0.0546)
Family size	0.115*** (0.00912)	0.131 (0.130)	0.115*** (0.00923)
Child dependency ratio	-0.214*** (0.0790)	-0.457 (1.069)	-0.212*** (0.0796)
old-age dependency ratio	-0.0905* (0.0531)	-1.069** (0.499)	-0.0836 (0.0532)

Regression model	Benchmark regression	First-stage regression	Second-stage regression
Explained variables	Household consumption	Digital finance index	Household consumption
	(1)	(2)	(3)
Do the family own a house	-0.0707*** (0.0262)	-0.516 (0.427)	-0.0679** (0.0264)
Is there a private loan	0.161*** (0.0156)	0.233 (0.215)	0.161*** (0.0155)
Is there a bank loan	0.162*** (0.0226)	-0.0639 (0.387)	0.161*** (0.0228)
Degree of economic development	-0.0607 (0.0808)	-0.594 (1.906)	-0.0571 (0.0807)
Financial deepening degree	0.00669 (0.00823)	-2.354 (1.462)	0.0193 (0.0157)
Household fixed effect	yes	yes	yes
Year fixed effect	yes	yes	yes
Sample size	17430	17430	17430
R ²	0.086	0.990	0.080
First Stage F-stat	—	—	12.36

Note: In brackets are the standard errors of robust clustering at the municipal level; *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$. Similarly hereinafter.

Secondly, the relationship between digital finance development and household consumption may be affected by endogeneity, which may lead to the error of estimation coefficient. Therefore, we use the instrumental variable estimation method to correct the endogeneity. Column (2) of Table 2 reports the regression results of the first stage to test the correlation statistically. Obviously, the instrument variable is significantly positively correlated with digital finance development, which is in line with the expectation.

Finally, column (3) of Table 2 further reports the regression results of two-stage least squares method for instrumental variables. The F statistic of weak instrumental variable test is greater than 10, which indicates that there is no weak instrumental variable problem in model estimation. More importantly, our research results are consistent with the benchmark regression, which further supports the conclusion that digital finance development promotes household consumption.

4.2. Digital Finance Development and Consumption Structure

The above endogeneity analysis shows that digital finance development can promote household consumption. The next question is, which kind of household consumption can be promoted by digital finance development, and then, has the development of digital finance changed the consumption behavior and structure? This

section is devoted to answering this question.

In order to investigate the impact of digital finance development on the consumption structure, in Table 3, this paper uses model (1) to estimate the expenditure of subdivided consumption items by two-stage least square method. Column (1) of Table 3 reports the impact of digital finance development on basic consumption, columns (2) to (3) respectively show the impact of digital financial development on basic consumption of food, clothing, housing and other types of consumption; column (4) of Table 3 reports the impact of digital financial development on development and enjoyment oriented consumption, and columns (5) to (6) respectively are the impact of digital finance development on development consumption and enjoyment consumption.

Table 3. Regression Results of Consumption Items

Explained variable	Basic consumption	Food and clothing	Housing and others	Development and enjoyment consumption	Development consumption	Enjoyment consumption
	(1)	(2)	(3)	(4)	(5)	(6)
Digital finance index	0.0120* (0.00642)	0.0177** (0.00782)	0.00256 (0.00918)	0.00508 (0.00579)	0.00505 (0.00564)	0.0104 (0.0185)
Household income	0.0277*** (0.00388)	0.0353*** (0.00559)	0.00929 (0.00649)	0.0155*** (0.00526)	0.0189*** (0.00590)	0.00803 (0.0149)
Control the characteristics of the head of household	yes	yes	yes	yes	yes	yes
Control the characteristics of the household	yes	yes	yes	yes	yes	yes
Control the characteristics of the region	yes	yes	yes	yes	yes	yes
Household fixed effect	yes	yes	yes	yes	yes	yes
Time fixed effect	yes	yes	yes	yes	yes	yes
Sample size	17375	17375	17429	17376	17376	17430
R ²	0.044	0.016	0.091	0.072	0.065	0.041
First Stage F-stat	12.43	12.43	12.36	12.36	12.36	12.36

According to the regression results of columns (1) to (3), digital finance development mainly promotes the basic consumption of households, especially the consumption of food and clothing, but has no significant impact on other types of consumption. This means that digital finance development has indeed changed the household consumption structure, that is, the consumption of food and clothing has been promoted. It is worth noting that this finding seems to imply that digital finance development may increase the Engel coefficient of households. In fact, before the development of digital finance in China, daily consumption of food, clothing and other daily life was often dependent on offline, and there were many inconveniences. This means that before

the development of digital finance, Chinese consumers' demand for food and clothing may be suppressed. The development of digital finance, just by reducing the off-line transaction costs, has brought convenience to the consumption of food and clothing goods, thus promoting the basic consumption. Therefore, digital finance development promotes the consumption of food and clothing, which cannot be simply interpreted as the rise of Engel coefficient, but should be understood as the release of household consumption potential in food and clothing.

4.3. Urban and Rural Sub-Sample Regression Results

There are still two groups with great difference in China: urban and rural residents. Therefore, the endogenous characteristics of China's urban-rural dual economy determine that the impact of digital finance development on urban and rural consumption may be heterogeneous. Next, we divide the urban and rural samples to explore the effect of digital finance development on the consumption of two types of residents.

Table 4 reports the heterogeneity of different types of consumption expenditure of urban and rural residents affected by digital finance development. Columns (1) and (2) are the estimated results of total consumption expenditure; columns (3) and (4) of basic consumption; and columns (5) and (6) of development and enjoyment consumption. We find that: firstly, digital finance development mainly drives the growth of urban consumption expenditure, especially the basic consumption; secondly, for rural residents, the impact of digital financial development on consumption is positive, but not statistically significant. These two findings show that the promotion effect of digital finance on household consumption mainly comes from the promotion of urban consumption. In fact, in the post-epidemic period of China, the way consumption boosting economic recovery further proves that the role of digital finance in promoting consumption mainly occurs in cities, not in rural areas.

The analysis in Table 4 shows that there is indeed urban-rural heterogeneity in the impact of digital finance development on consumption. There are two reasons. First, although digital technology has overcome the natural limitations of traditional finance, there has been a serious urban-rural division in China for a long time. The difference in the consumer goods market caused by this urban-rural division will lead to the relative shortage of rural consumption, thus making the development of digital finance impossible to raise the rural consumption level. Second, there may also be a digital divide among rural residents, which prevents those who lack effective access to information and who do not make full use of it from participating in and sharing the fruits of digital finance development, thereby creating "marginalized" groups in the digital society, which also makes digital finance development unable to benefit these groups.

Table 4. Regression Results of Urban and Rural Sub-Samples

Explained variable						
	Household consumption		Basic consumption		Development and enjoyment consumption	
	Urban residents	Rural residents	Urban residents	Rural residents	Urban residents	Rural residents
	(1)	(2)	(3)	(4)	(5)	(6)
Digital finance index	0.0105* (0.00582)	0.00100 (0.00573)	0.0129* (0.00689)	0.000583 (0.00676)	0.00629 (0.00646)	0.000351 (0.00936)
Household income	0.0125*** (0.00429)	0.0292*** (0.00644)	0.0175*** (0.00488)	0.0389*** (0.00662)	0.0135** (0.00668)	0.0189** (0.00813)
Control the characteristics of the head of household	yes	yes	yes	yes	yes	yes
Control the characteristics of the household	yes	yes	yes	yes	yes	yes
Control the characteristics of the region	yes	yes	yes	yes	yes	yes
Household fixed effect	yes	yes	yes	yes	yes	yes
Time fixed effect	yes	yes	yes	yes	yes	yes
Sample size	7424	9707	7395	9681	7402	9674
R ²	0.144	0.054	0.118	0.026	0.085	0.064
First Stage F-stat	14.82	4.989	15.07	4.941	14.73	5.026

5. Analysis of the Internal Mechanism of the Impact of Digital Finance Development on Household Consumption

The above research found that digital finance development has a significant role in promoting household consumption, and this promotion effect mainly comes from the consumption of urban households. Next, we limit the perspective to urban residents, and further investigate the internal mechanism of the impact of digital finance development on household consumption.

5.1. Analysis Based on the Convenience of Payment

First of all, the important feature of digital finance development lies in facilitating payment and accelerating consumer decision-making. Therefore, it is possible to promote urban consumption through this channel.

In column (1) of Table 5, we examine the impact of digital finance development on payment frequency and find that digital finance development significantly increases the frequency of payment for urban residents, thus characterizing the convenience of payment. Further, in columns (2) to (4) of Table 5, we examine the effect of

increased payment frequencies driven by the development of digital finance on urban consumption.

The above results show that the increased payment frequency promotes urban consumption, especially the basic consumption. This means that digital finance development promotes household consumption, partly because it has promoted the improvement of payment convenience.

Table 5. Digital Finance Development, Payment Convenience and Household Consumption

Explained variable	Payment frequency	Household consumption	Basic consumption	Development and enjoyment consumption
	(1)	(2)	(3)	(4)
Digital finance index	0.0156* (0.00914)			
Payment frequency		0.0216* (0.0129)	0.0200* (0.0114)	0.0145 (0.0186)
Household income	0.00512 (0.0150)	0.0123* (0.00725)	0.0217*** (0.00686)	0.00967 (0.0103)
Control the characteristics of the head of household	yes	yes	yes	yes
Control the characteristics of the household	yes	yes	yes	yes
Control the characteristics of the region	yes	yes	yes	yes
Household fixed effect	yes	yes	yes	yes
Time fixed effect	yes	yes	yes	yes
Sample size	4358	4382	4363	4370
R ²	0.109	0.085	0.054	0.063
First Stage F-stat	12.61	—	—	—

5.2. Analysis Based on the Permanent Income and Life-Cycle Hypothesis

Next, we discuss the second possible mechanism: digital finance development can promote the growth of household consumption by affecting household disposable income.

In column (1) of Table 6, we investigate the impact of digital finance development on household income, and find that it does not significantly affect urban household income, indicating that digital finance has no income growth effect. According to the regression results in column (2), both digital finance development and household income have a significant role in promoting household consumption, and are the main affecting factors.

The above results show that the mechanism based on the permanent income and life-cycle hypothesis has not been verified in this paper. This means that there may be some factors in the determinants of household consumption that cannot be explained by this hypothesis, and digital finance development is related to these factors, thus promoting household consumption.

Table 6. Digital Finance Development, Household Income and Household Consumption

Explained variable	Household income (1)	Household consumption (2)
Digital finance index	0.0233 (0.0178)	0.0114** (0.00582)
Household income		0.0137*** (0.00440)
Control the characteristics of the head of household	yes	yes
Control the characteristics of the household	yes	yes
Control the characteristics of the region	yes	yes
Household fixed effect	yes	yes
Time fixed effect	yes	yes
Sample size	6609	6609
R ²	0.030	0.152
First Stage F-stat	14.42	14.48

5.3. Analysis Based on the Motive of Precautionary Saving

Next, we further discuss the third possible mechanism: digital finance development can promote household consumption by reducing the credit risk and uncertainty faced by families.

In practice, variables including the variance of income change (Song, 1999) and the variance of consumption change (Carroll and Samwick, 1998) are widely used to measure the risk or uncertainty faced by families. In Table 7, referring to existing studies, we choose the standard deviation of expenditure to represent the uncertainty faced by households, divide the sample into two groups of households with high and low uncertainty, and then use the two-stage least square method to estimate the impact of digital financial development on household consumption expenditure under different precautionary motivations.

The results present us with the evidence that digital finance development can change household consumption through the mechanism of precautionary savings: first, digital finance development improves the consumption of households facing high uncertainty; secondly, when further analyzing the impact of digital financial development on basic consumption, we find that although digital finance development

can improve the consumption level of two types of households at the same time, the coefficient of households facing high uncertainty is significantly higher than that of the other group in size and significance; finally, the impact of digital finance development on the development and enjoyment consumption of the two types of households is not significant. To sum up, we believe that the precautionary saving motivation can explain the promoting effect of digital financial development on household consumption to a certain extent.

Table 7. Digital Finance Development, Precautionary Savings and Household Consumption

Explained variable	Household consumption		Basic consumption		Development and enjoyment consumption	
	Low uncertainty	High uncertainty	Low uncertainty	High uncertainty	Low uncertainty	High uncertainty
	(1)	(2)	(3)	(4)	(5)	(6)
Digital finance index	0.00366 (0.00361)	0.0181* (0.00930)	0.00870* (0.00471)	0.0185** (0.00925)	-0.00159 (0.00560)	0.0160 (0.0108)
Household income	0.0131* (0.00726)	0.0145** (0.00595)	0.0143* (0.00766)	0.0230*** (0.00738)	0.0168 (0.0115)	0.0114 (0.00822)
Control the characteristics of the head of household	yes	yes	yes	yes	yes	yes
Control the characteristics of the household	yes	yes	yes	yes	yes	yes
Control the characteristics of the region	yes	yes	yes	yes	yes	yes
Household fixed effect	yes	yes	yes	yes	yes	yes
Time fixed effect	yes	yes	yes	yes	yes	yes
Sample size	3303	3306	3294	3296	3301	3296
R ²	0.150	0.147	0.112	0.145	0.089	0.085
First Stage F-stat	14.72	13.66	14.67	13.91	14.71	13.46

5.4. Analysis Based on Liquidity Constraints

Finally, we examine the fourth possible mechanism mentioned above: that is, digital finance development can relax the liquidity constraints of households through borrowing and other forms, so that households can follow the principle of utility maximization to improve consumption.

In Table 8, referring to Gao (2008), we construct a dummy variable to represent the liquidity constraints, and then divide the samples into two groups of households with higher and lower liquidity constraints. Then, we use the two-stage least squares method to estimate the impact of digital financial development on household consumption

expenditure under different household borrowing constraints.

The results indicate that there is no clear evidence that digital finance development can change household consumption through the mechanism of liquidity constraints: first, digital finance development has increased the consumption of households with low liquidity constraints; secondly, when we further analyze the impact of digital finance development on basic consumption, we also draw similar conclusions; finally, the development of digital finance has no significant effect on the development and enjoyment consumption of two types of households. To sum up, although digital finance development has relaxed the liquidity constraints, the liquidity constraints may not be the main mechanism for digital finance development to promote household consumption, and there may be other factors that have not been observed.

Table 8. Digital Finance Development, Liquidity Constraints and Household Consumption

Explained variable	Household consumption		Basic consumption		Development and enjoyment consumption	
	Low liquidity constraints	High liquidity constraints	Low liquidity constraints	High liquidity constraints	Low liquidity constraints	High liquidity constraints
	(1)	(2)	(3)	(4)	(5)	(6)
Digital finance index	0.0132* (0.00688)	0.00569 (0.00547)	0.0121** (0.00586)	0.00885 (0.00595)	0.0154 (0.0102)	0.000625 (0.00934)
Household income	0.0119** (0.00502)	0.0609** (0.0261)	0.0168*** (0.00542)	0.0671** (0.0278)	0.0125 (0.0102)	0.0659** (0.0298)
Control the characteristics of the head of household	yes	yes	yes	yes	yes	yes
Control the characteristics of the household	yes	yes	yes	yes	yes	yes
Control the characteristics of the region	yes	yes	yes	yes	yes	yes
Household fixed effect	yes	yes	yes	yes	yes	yes
Time fixed effect	yes	yes	yes	yes	yes	yes
Sample size	3309	2111	3295	2099	3303	2098
R ²	0.173	0.138	0.171	0.107	0.085	0.096
First Stage F-stat	15.66	18.85	15.87	19.03	15.61	18.57

6. Robustness Test

To increase the credibility of the conclusion of this paper, robustness test will be

carried out in this section. First, the problem of measurement error may be solved by correcting the value of core variables. Specifically, in view of the fact that the data of household consumption and income are often underestimated to a certain extent in household surveys, this paper conducts a 1% tail reduction treatment according to the standard method. On this basis, we use model (1) for re-estimation, and the results are shown in column (1) of Table 9.

Secondly, the benchmark model is re-estimated by constructing new instrumental variables. The results are shown in column (2) of Table 9. Specifically, drawing on the practice of Zhang *et al.* (2019), this paper selects two types of instrumental variables, namely, the spherical distance between the home residence and Hangzhou, and the spherical distance between the region where the family is located and the provincial capital, and re-estimates it by using model (1).

All the results in Table 9 pass the test of weak instrumental variables and significance test, which shows that digital finance development has indeed significantly promoted household consumption, and further proves the reliability of the benchmark estimation results.

Table 9. Robustness Analysis

Explained variable	Correction of measurement error	Re-discussion on Endogeneity
Household consumption	(1)	(2)
Digital finance index	0.00983* (0.00548)	0.00498** (0.00245)
Household income	0.0201*** (0.00368)	0.0220*** (0.00434)
Control the characteristics of the head of household	yes	yes
Control the characteristics of the household	yes	yes
Control the characteristics of the region	yes	yes
Household fixed effect	yes	yes
Time fixed effect	yes	yes
Sample size	17430	15507
R ²	0.083	0.084
First Stage F-stat	12.36	10.63

7. Conclusions and Recommendations

Based on the data of CFPS, this paper discusses the relationship between digital finance development and household consumption from a micro perspective. We find that digital finance development mainly promotes the growth of urban consumption expenditure, especially the basic consumption expenditure of food and clothing.

Comparatively speaking, it has no significant impact on rural consumption and development and enjoyment consumption expenditure. On this basis, this paper verifies that digital finance promotes consumption growth mainly by improving the convenience of payment and reducing the uncertainty faced by households.

Based on the research, this paper has the following policy recommendations:

First, it is necessary to improve the development of information infrastructure in rural and remote areas, make digital technology achievements more beneficial, convenient and beneficial to the people, constantly narrow the digital gap between urban and rural areas in terms of information accessibility, and promote the growth and upgrading of rural consumption. At the same time, we should speed up the construction of new infrastructure such as 5G, artificial intelligence, industrial Internet and Internet of things, ensure the development advantages of digital technology in China, and provide more powerful hardware guarantee for the promotion of consumption development by digital finance.

Second, we should give digital finance full play and promote the basic consumption demand by issuing e-vouchers. At the same time, digital financial products should be more oriented to the development and enjoyment consumption of households, stimulate and promote medium and high-end consumption, and more effectively serve the consumption upgrading.

Third, we should follow the internal mechanism of digital finance driving consumption, and ensure that digital finance promotes consumption from two aspects: first, we should encourage Internet platform institutions to deeply participate in digital financial innovation, provide users with more and better digital financial service products, further improve the convenience of payment and facilitate consumption; second, we should strengthen financial supervision and reduce the costs of digital financial services, improve the credit risk prevention and control mechanism, constantly optimize the social credit environment, improve the liquidity constraints and uncertainty expectations of households, and give greater play to the role of digital finance in promoting household consumption.

Fourth, in accordance with the principle of combining long-term and long-term development, while stepping up efforts to ensure stability on six fronts and maintain security in six areas, we should implement precise stimulus in the short term, promote the optimization and upgrading of commodity consumption, promote the quality and expansion of service consumption, accelerate the cultivation of new types of consumption, and take multiple measures to promote the recovery of consumption. In the long run, to promote the virtuous cycle and interactive development of digital finance and the real economy, on the one hand, digital finance should effectively serve the real economy development, promote personal income growth and ensure the sustainable growth of household consumption, on the other hand, the real economy should better integrate and develop with digital technology, provide better goods and

more convenient services for consumers, and provide a long-term and stable material basis for the upgrading and expansion of household consumption.

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