Digital Economy, Financial Inclusion and Inclusive Growth

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Abstract: *This paper represents an early attempt to investigate whether digital finance driven by the internet revolution helps promote inclusive growth in China. We match the Index of Digital Financial Inclusion, which measures digital finance development in China, with data of the China Family Panel Studies (CFPS), which provide representative household survey data in China. Firstly, based on sub-sample empirical analysis, we find that digital finance has helped increase household income, especially rural household income, in China. Thus, digital finance is conducive to inclusive growth in China by narrowing regional and urban-rural gaps. Secondly, we examine how digital finance spurs inclusive growth in China by bringing rural households equal access to entrepreneurship opportunities. Lastly, we uncover how digital finance interacts with physical capital and social capital in promoting entrepreneurship, concluding that households with less physical or social capital had benefited more, which is also conducive to inclusive growth.*

Keywords: *digital economy, digital finance, financial inclusion, inclusive growth, entrepreneurship*

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1. Introduction

As another major technology revolution after humankind invented the steam engine and harnessed electric power, the internet revolution enabled by computers has transformed the world economy and people's ways of life (Jiang, 2018). From an economic perspective, the transformative effects of the internet can be attributed to efficiency (growth) and fairness (income distribution). The existing body of literature is preoccupied with the efficiency effects of the internet, and seldom investigates how the internet helps narrow wealth gaps, which have topped the agenda of governments, the international community and academia.

China has benefited enormously from the internet revolution. Over the past five to ten years, China's digital economy - not least digital finance - has developed rapidly, as evidenced in the broad usage of Alipay and WeChat Pay. Growing availability and convenience of financial services as a result of digital finance have increased financial inclusion in China, especially for people who otherwise could not access financial markets. Credit cards, for instance, are an important tool for individuals to build credit history

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as reference when they borrow from banks. According to the China Society for Banking Statistics (2016), China's issuance of credit cards reached 530 million by 2015. Even if those credit cards were issued to an exactly equal number of people, more than half of China's population are still without a credit card and credit history, and thus cannot access funds from traditional financial markets. In this sense, traditional finance is not inclusive for all Chinese nationals.[1] Fortunately, the role of digital finance comes into play: Even without a credit history, most people may still generate credit records when they pay for utilities, shopping or meals with WeChat Pay or Alipay. Such records are already vetted for credit applications at digital finance platforms such as Ant Cash Now and WeBank. In this manner, the internet-enabled digital economy and digital finance benefit people who are underserved by traditional finance and credit reference systems by easing their credit constraint and allowing them to invest and do business with credit. Foreseeably, the internet-based information or data creation and sharing will give rise to a digital finance industry, improve financial availability and inclusion, and promote inclusive growth.

As one of "4I" themes at the G20 Summit held in Hangzhou in 2016, inclusive growth will, to some extent, shape the future course of world economic development. Regretfully, there is a paucity of empirical research in Chinese and international literature on this topic (Zhang and Wan, 2016). Most previous studies are descriptive, focusing on the concepts and importance of inclusive growth, as well as policy advice, and seldom offer empirical analysis on inclusive growth, not to mention the inclusive growth effects of internet-driven digital economy and digital finance. This blind spot is regrettable as digital finance has become a way of life for average people in China in just a few years. Given the downward pressures on China's economy, significant income inequalities remain. It thus becomes particularly relevant to conduct a systematic and objective study on how digital finance contributes to inclusive growth.

In this context, this paper for the first time matches the Index of Digital Financial Inclusion with the China Family Panel Studies (CFPS) to evaluate the inclusive growth effects of digital finance development driven by the internet revolution.

2. Literature Review and Research Paper Innovations

This paper seeks to investigate whether digital finance is conducive to inclusive growth in China, and discusses the intrinsic mechanism of such effects from a family entrepreneurship perspective. Relevant research literature can be summarized in the following areas:

First, the literature on the economic effects of financial development. It is widely recognized that financial development is conducive to economic growth (King and Levine, 1993; Rajan and Zingales, 1998). The core function of finance is to optimize resource allocation and minimize risks. Relevant empirical studies also find that financial development is conducive to smoothing consumption, managing risks, mitigating household credit constraint, and facilitating transactions (Goldsmith, 1969; McKinnon, 1973; Levine, 2005). In particular, Levine's (2005) classical papers have theoretically and empirically proven that a more sophisticated financial system can mitigate firms' external financing constraint. According to the "financial accelerator" theory by Bernanke *et al*. (1999), financing constraint is a determinant of economic growth acceleration or decline.

As a combination of the internet and finance, the digital economy - not least digital finance - naturally takes on financial attributes. Also, previous studies suggest that the digital economy is conducive to financial inclusion and thus propel economic growth, especially in China. Li (2015)

[1] Another evidence is that by April 24, 2019, China had collected information about 990 million people, and there were still 460 million natural persons without any credit record. See: http://finance.sina.com.cn/roll/2019-04-24/doc-ihvhiqax4733019.shtml.

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believes that internet finance driven by the rapid development of e-commerce and IT in China is conducive to financial inclusion by making traditional finance less dependent on brick-and-mortar outlets and boast more geographical penetration and low-cost advantages. Jiao (2014) notes that mobile internet creates conditions for financial services to be extended to the vast less developed regions. In particular, digital currency plays a vital role in expanding financial service coverage and reducing service cost (Jiao *et al*., 2015). Hence, digital finance is conducive to improving financial assets allocation, SMEs' access to financing, financial stability, and overall profitability (Wang and Lu, 2012). Guo *et al*. (2019) concludes that as an important role for achieving low-cost, broad-coverage and sustainable financial inclusion, digital finance offers a possibility for less developed regions to catch up.

In recent years, a host of literature studies have been conducted to assess the economic effects of digital finance. Kapoor (2013) finds that digital finance induces economic growth. Based on the Index of Digital Financial Inclusion of China, Song (2017) finds that digital finance helps narrow urban-income gaps. With regional corporate innovation data, Xie *et al*. (2018) also employs this index to prove that digital finance is conducive to firm innovation. Huang and Huang (2018) systematically reviews the journey of digital finance development in China, and offers an outlook on the future of digital finance. With macroeconomic data, however, these papers are concerned with how digital finance contributes to economic development, regional inequality, firm innovation and entrepreneurship at the macro level without identifying the microscopic mechanism of digital finance's economic effects. As the only exception, Yi and Zhou (2018) finds that digital finance promotes household consumption by facilitating payments and mitigating liquidity constraints. Obviously, more studies need to be carried out to uncover the microscopic mechanism of digital finance's economic effects.

Another category of research literature is concerned with inclusive growth. As mentioned before, inclusive growth is as much about efficiency as it is about fairness. Zhang and Wan (2016) examines the inclusive growth effects of rural infrastructure in China, and a few other studies have focused on the efficiency or distribution dimension of inclusive growth. Based on the above-mentioned Kapoor's (2013) and Song's (2017) findings, it seemingly can be concluded that digital finance will induce inclusive growth. Yet their study is based on macro-level data and cannot reveal the microscopic mechanism; urban-rural income gaps are only part of overall income distribution, and more significant disparities may exist within China's countryside and cities (Wan, 2008a; 2008b). Against the backdrop of the internet revolution, there is a need to conduct a systematic and stringent analysis of the relationship between digital finance and inclusive growth.

The third category of research is related to family entrepreneurship. Overall, the microscopic determinants of entrepreneurship include entrepreneurs' gender (Rosenthal and Strange, 2012), age (Rees and Shah, 1986), human capital (Lazear, 2005), social capital (Hu and Zhang, 2014; Zhou *et al*., 2015), work experience (Evan and Leighton, 1989; Wang, 2014; Zhou *et al*., 2017), risk preference (Parker, 1996), among others. At the macro level, political, economic, cultural and social environments also play a role in a person's decision to start a business (Djankov, 2002; Glaeser and Kerr, 2009; Ghani *et al*., 2014; Wu *et al*., 2014; Zhou *et al*., 2015). International literature also suggests that entrepreneurship not only promotes innovations and long-term economic growth (Baumol, 1968; King and Levine, 1993; Samila and Sorenson, 2011), but solves the unemployment problem as well (De Mel *et al*., 2008).

Although previous studies did not touch upon the relationship between digital finance and entrepreneurship, those dealing with the relationship between financial development and entrepreneurship provides reference for this paper. Classical literature believes that credit restraint will exert a negative impact on entrepreneurship (Evans and Jovanovic, 1989; Nykvist, 2008; Karaivanov, 2012). Financial development will promote entrepreneurship by allocating resources more effectively to those in need and mitigating the credit constraints facing potential entrepreneurs (Bianchi, 2010). Foreseeably, IT, big data, cloud computing and other innovations will help achieve equal access to entrepreneurship opportunities by further expanding the scope and accessibility of financial services, mitigating financial constraint, and

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facilitating family entrepreneurship.

Compared with existing literature, this paper seeks to make the following innovations:

First, the Index of Digital Financial Inclusion of China, which is jointly formulated by the Institute of Digital Finance of Peking University and Ant Financial Service Group, is employed for the first time to investigate how the digital economy and digital finance contribute to inclusive growth in China in the context of the internet revolution and the burgeoning digital economy.

Second, the Index of Digital Financial Inclusion of China is matched with data from the China Family Panel Studies (CFPS) to examine the effects of digital finance on household income and family entrepreneurship, broadening discussions on the microscopic mechanism of digital finance's economic effects.

Third, further analysis is carried out to uncover how digital finance influences entrepreneurship through the heterogeneity of material, human and social capital, contributing to the body of literature on the determinants of entrepreneurship.

3. Empirical Strategies and Data

3.1 Model Specification: Digital Finance and Inclusive Growth

First of all, we create a model for the relationship between digital finance and household income, where Inc_{ijt} is the income of household i in city j of region t, and digital finance's development in the household's city is expressed as $IF_{j,t\text{-}1}$. Logarithm of household income is taken to correct for deviation. The empirical model is specified as follows:

$$ln(Inc_{ijt}) = \gamma_0 + \gamma_1 IF_{j,t\text{-}1} + \gamma_2' X_{ijt} + \phi_i + \varphi_t + u_{ijt} \quad (1)$$

In Equation (1), X_{ijt} is the control variable for household head, household and region; ϕ_i is the household fixed effect; φ_t is the time fixed effect; u_{ijt} is stochastic disturbance term. To mitigate the possibility of reverse causality, we set a one phase lag for the Index of Digital Financial Inclusion. Given that our analysis targets at the relationship between digital finance development and household income at the regional level, we cluster standard errors at the regional level to avoid the impact of correlation among households within a region on the model's estimation results. Based on Equation (1), γ_1 measures the overall effects of digital finance on household income.

Digital finance may not be the only conduit through which the internet and digital economy influence household income. Hence, we have controlled for the dummy variable of the household head's access to the internet and mobile phone to avoid deviation that may result from variable omission. To distinguish the effects of digital finance and traditional finance on household income, we also introduce the size of bank loans at the household level as a proxy variable for the development of traditional finance. We will take steps to include factors at the household head, overall household and regional levels to verify the robustness of the estimated value for the critical explanatory variable (digital finance development).

Equation (1) estimates the overall household income effects of digital finance. To further analyze whether digital finance has promoted inclusive growth, we need to further discuss the income distribution effects of digital finance under Equation (1) framework. Referencing Zhang (2015), this paper employs sub-samples regression and quantile[2] regression methods to discuss the income distribution effects of digital finance between cities and the countryside, regions and cities and within cities and the countryside to explain the relationship between digital finance and inclusive growth.

[2] Due to space limit, the results of quantile regression are not reported here, but available upon request to the first author.

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3.2 Transmission Mechanism: Digital Finance and Entrepreneurship

Inclusive digital finance allows more people to access credit support, mitigates credit constraints, and helps SMEs and micro-businesses to be created (Evans and Jovanovic, 1989; Nykvist, 2008; Bianchi, 2010; Karaivanov, 2012), thus creating jobs and inducing inclusive growth. To verify this transmission mechanism, we create a binary choice model, in which family entrepreneurship is the explained variable. Normally, family entrepreneurship is a dummy variable, behind which there is a continuous latent variable. This latent variable can be seen as the net welfare or utility of entrepreneurship. When the underlying variable is greater than zero, i.e. when the net welfare or utility of entrepreneurship is positive, a family will decide to venture into business, and vice versa. Whether a family decides to set up a business becomes the observable value of this latent variable. In this paper, the expressions of the latent variable and the binary choice model are as follows:

$$Entrepre^{*}_{ijt}=\beta_0+\beta_1 IF_{j,t-1}+\beta_2 X_{ijt}+\theta_j+\delta_t+\mu_{ijt}$$

$$Prob(Entrepre_{ijt}=1)=Prob(Entrepre^{*}_{ijt}>0)=\Phi(\beta_0+\beta_1 IF_{j,t-1}+\beta_2 X_{ijt}+\theta_j+\delta_t) \qquad (2)$$

Where, X_{ijt} is control variable; θ_j is the dummy variable of the household's city; δ_t is the dummy variable of year. Coefficient β_1 measures the overall effects of digital finance on family entrepreneurship.

Control variables in Equation (2) are roughly consistent with those in Equation (1) except for the inclusion of net household income. In addition, if Equation (2) is estimated by Probit model, the problems of missing variables and endogeneity are likely to occur since only the region-level dummy variable is controlled for. For instance, the acceptance of new ideas/risks varies among families. The likes of such factors influence the development of digital finance and entrepreneurship, but are hard to measure. Reverse causality may also exist as entrepreneurship may lead to cheaper and more convenient access to the internet, which is conducive to digital finance. In the robustness analysis, we create a linear probability model and conditional logit model to control for the problem of missing variables; on the other hand, we also employ the instrumental variables of the spherical distance between a household's region and the city of Hangzhou, as well as the spherical distance between a household's region and the nearest provincial capital to obtain more reliable conclusions.[3]

3.3 Data

To estimate Equation (1) and (2), we use two sources of data. The first part of data is from the Index of Digital Financial Inclusion of China with samples ranging from 2011 to 2018. Jointly compiled by the Institute of Digital Finance of Peking University and Ant Financial Services Group, this index is based on the big data of Ant Financial's transaction accounts, and is highly representative and reliable (Guo *et al*., 2019). The other source of data is from the China Family Panel Studies (CFPS) of the Institute of Social Science Survey of Peking University. Launched in 2010, the CFPS survey has been carried out every two years to collect data at the levels of individuals, families and communities to capture China's social, economic, demographic and educational changes. The CFPS contains 16,000 target samples from 162 counties in 25 provinces/municipalities/autonomous regions, and respondents includes all members of the sample households. Then, the above-mentioned two sources of data are consolidated by city to obtain household data for 2012, 2014 and 2016 and the Index of Digital Financial Inclusion for 2011, 2013 and 2015. Table 1 offers a statistical description of relevant variables.

(1) Household net income. The variable of household net income is from the household questionnaire in the CFPS database, which includes salary income, operating income, property income, transferred income and other incomes. We take the logarithm of household net income to correct for deviation. Table 1 shows that from 2012 to 2016, there was an increase in household income.

[3] Ibid.

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Table 1: Statistical Description of Variables

Variable	2012			2016		
	Samples	Mean	Standard Deviation (SD)	Samples	Mean	Standard Deviation (SD)
Net household income (logarithm)	8,280	10.018	10.018	6,848	10.214	1.354
Family entrepreneurship status (Started a business=1)	8,280	0.0959	0.294	6,848	0.0911	0.288
Did the family venture into business? (From no to yes=1)	8,280	0.0551	0.228	6,848	0.0388	0.193
Index of Digital Financial Inclusion	8,280	53.248	17.013	6,848	173.607	21.942
Gender of household head (male=1)	8,280	0.734	0.442	6,848	0.745	0.436
Age of household head	8,280	52.660	12.388	6,848	56.028	12.354
Years of education	8,280	6.650	4.761	6,848	6.522	4.698
Political background (Party member=1)	8,280	0.129	0.335	6,848	0.133	0.340
Marriage (married=1)	8,280	0.876	0.329	6,848	0.873	0.333
Health (healthy=1)	8,280	0.582	0.493	6,848	0.597	0.490
Access to the internet	8,280	0.106	0.308	6,848	0.249	0.432
Access to mobile phone	8,280	0.746	0.435	6,848	0.887	0.317
Family size	8,280	3.753	1.765	6,848	3.801	1.873
Proportion of children	8,280	0.158	0.198	6,848	0.154	0.195
Proportion of elderly family members	8,280	0.239	0.346	6,848	0.299	0.370
Size of bank loans	8,280	0.844	2.893	6,848	1.366	3.680
Total population of village/community (logarithm)	8,280	7.919	0.938	6,848	7.876	0.922
Economic status of village/community	8,280	4.378	1.143	6,848	4.427	1.105

(2) Entrepreneurship. Given that the decision to start a business is jointly made by all family members and family financial data cannot be decomposed into each family member, we choose to define the variable of entrepreneurship at the household level. In this paper, the method for creating the entrepreneurship variable is as follows: If a family member did not set up any individual or private business in the previous year of survey but did so in the current year of survey, the value of entrepreneurship variable is 1; if the entrepreneurship status of a household remains unchanged between the two years, this variable is assigned the value of 0. Households that had quit their business ventures are not analyzed due to their small proportion (only 1%), and relevant observations are excluded. When creating the entrepreneurship variable at the household level for 2012, we have also used the data of household entrepreneurship status for 2010. Table 1 indicates an increase in the percentage of households running a business despite a fall in the percentage of households opening new businesses. We are concerned with whether digital finance has significantly influenced entrepreneurship in China.

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(3) Digital finance. The development of digital finance is measured by city-level Index of Digital Financial Inclusion of China. Table 3 indicate that the mean value of the Index of Digital Financial Inclusion rose sharply from 53.248 in 2011 to 173.607 in 2015.

(4) Other variables. Other variables that influence household income and entrepreneurship employed in this paper can be obtained from the following three types of questionnaire. The adult questionnaire collects information about household head's gender, age, years of education, political background, marital status, health and access to the internet and mobile phone. The household questionnaire and family relationship questionnaire collect information about family size, the proportion of juvenile family members, the proportion of elderly family members, and household indebtedness to banks. Community questionnaire collects information about total village/community population and economic conditions.[4]

4. Digital Finance and Inclusive Growth

In this section, we will analyze the relationship between digital finance and inclusive growth. After estimating the benchmark model of digital finance and household income, we will assess the inclusive growth effects of digital finance based on its heterogeneous effects on household income.

4.1 Digital Finance and Household Income

Based on Equation (1), we conduct an ordinary least square (OLS) regression with the two-way fixed-effect model. Table 2 reports the regression results.

In Column (1) of Table 2, we only consider the relationship between the development of digital finance (with one-phase lag) and the household income. From Columns (2) to (4), we take steps to control for the attributes of household head, household and regional economy. We find that among all regressions, the estimated coefficients for the development of digital finance are all positive, which

Table 2: Digital Finance and Household Income: Benchmark Model

Dependent variable (based on household net income)	(1)	(2)	(3)	(4)
Index of Digital Financial Inclusion	0.0073**	0.0070**	0.0069**	0.0070***
	(0.0028)	(0.0028)	(0.0027)	(0.0026)
Control variables for household head	No	Yes	Yes	Yes
Control variables for household	No	No	Yes	Yes
Control variables for region	No	No	No	Yes
Household fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	22,019	22,019	22,019	22,019
R^2	0.7067	0.7072	0.7209	0.7209

Note: Numbers in parentheses are the cluster robust standard error, and *** p<0.01, ** p<0.05, * p<0.1. The same below.

[4] Defined as the economic conditions in a village/neighborhood observed by surveyors, and the range of value is from 1 to 7; 1 means very poor, and 7 means very rich.

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means that the development of digital finance is conducive to household income. In terms of economic significance, when the Index of Digital Financial Inclusion moves up by one standard deviation, household income will steadily increase by 11.9-15.4 percentage points.

In observing other control variables, we find that the coefficients of control variables for household head are generally insignificant. A possible reason is that such variables remain constant or experience little change over time for most households. Hence, their effects are largely included in the household fixed effect. Overall household attributes help explain household income. While household size is positively correlated with household income, the increasing dependency ratios of juvenile and elderly family members tend to dent household income. Notably, the two variables of whether the household head has access to the internet and mobile phone are both insignificant, indicating that digital finance is a key conduit through which the digital economy exerts an influence on household income. As the proxy variable of traditional finance, the coefficient for the amount of household bank loans is insignificant, which means that the importance of digital finance cannot be fully substituted by traditional finance. All these results are consistent with expectations. Lastly, the coefficients for the total population and economic status of villages, towns or neighborhood committees are also insignificant - both variables measure the level of regional economic development. A possible reason is that compared with household income, these two variables are slow variables, whose impact cannot be identified in the short run.

4.2 Development of Digital Finance and Inclusive Growth (or Income Inequality)

As can be inferred from above discussions, people without credit history in China are mainly from the countryside, and the vast majority of prosperous urbanites already have access to financial and information services. If rural residents can be proven to have benefited more from digital finance, it means that digital finance has an inclusive effect on income growth.

Table 3 reports the results of estimating Equation (1) with urban and rural samples. Columns (1)-(2) of Table 3 are results for rural residents, and Columns (3)-(4) are results for urban residents. Consistent with expectations, digital finance has a significantly positive household income effect only for rural residents, and the effect is insignificant for urbanites. Based on the regression results of Column (2),

Table 3: Digital Finance's Income Effects for Urban and Rural Households

Dependent variable (based on household net income)	(1)	(2)	(3)	(4)
	Rural samples		Urban samples	
Index of Digital Financial Inclusion	0.0093*	0.0100**	0.0041	0.0036
	(0.0053)	(0.0050)	(0.0038)	(0.0035)
Control variables for household head	Yes	Yes	Yes	Yes
Control variables for household	No	Yes	No	Yes
Control variables for region	No	Yes	No	Yes
Household fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	11,832	11,832	10,187	10,187
R^2	0.6766	0.6921	0.7438	0.7547

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when the Index of Digital Financial Inclusion moves up one standard deviation, rural household income will rise by 17.0-21.9 percentage points, which is a large increase for fairly.[5]

5. Transmission Mechanism: Development of Digital Finance and Family Entrepreneurship

As demonstrated in our prior analysis, digital finance influences income growth through the intermediate link of entrepreneurship, i.e. it conforms to the transmission mechanism where digital finance increases financial inclusion that ensures equal access to entrepreneurship opportunities and thus promotes inclusive growth. Through a regression analysis, this section will further verify this transmission mechanism.

5.1 Benchmark Analysis of Digital Finance and Family Entrepreneurship

First, we estimate Equation (2) as a Probit model to examine the relationship between digital finance and family entrepreneurship with results shown in Table 4. Since the Probit model often leads to deviations after fixing the household effect (Hsiao, 2003), we have only controlled for the spatial fixed effect and time fixed effect among all regressions. Yet we have also included variables that remain constant over time, such as the household head's gender, age (first-order term), length of education and political background to partially control for the household fixed effect.

Column (1) of Table 4 only considers the Digital Financial Development Index; Columns (2)-(4) gradually add the control variables of household head, household and region. We find that in all regressions, the coefficients for the development of digital finance are all insignificant, meaning that digital finance has a limited effect on family entrepreneurship in China. Yet this result does not suggest that the effects of digital finance are insignificant for all households. It is likely that the main benefit of

Table 4: Development of Digital Finance and Family Entrepreneurship: Benchmark Analysis

Dependent variable (based on whether a household ventures into business)	(1)	(2)	(3)	(4)
Index of Digital Financial Inclusion	0.0016	0.0004	0.0022*	0.0005
	(0.0012)	(0.0012)	(0.0012)	(0.0013)
Control variables for household head	No	Yes	Yes	Yes
Control variables for household	No	No	Yes	Yes
Control variables for region	No	No	No	Yes
Spatial fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	22,019	22,019	22,019	22,019
Pseudo R^2	0.0243	0.0409	0.0721	0.0765

[5] Our study on the relationship between digital finance and inclusive growth based on the interaction term between cities and the countryside led to similar findings. In the interest of length, these findings are not reported here, but available upon request to the first author.

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digital finance, which is to help entrepreneurial families overcome capital threshold, does little to help most urban residents who already have access to a wide array of financial services and information and are able to procure funds to start a business. In comparison, rural residents are more likely to benefit from digital finance. Due to such heterogeneity, regression results in Table 4 are insignificant. In the next section, therefore, we will examine whether digital finance influenced entrepreneurship heterogeneously for urban and rural residents in China has.

5.2 Digital Finance's Heterogeneous Entrepreneurship Effects for Urban and Rural Households

Table 5 presents the heterogeneous entrepreneurship effects of digital finance for urban and rural residents. Columns (1)-(2) of Table 5 are results for rural samples, and Columns (3)-(4) are results for urban samples. Consistent with expectations, digital finance has a significantly positive entrepreneurship effect only for rural residents, and the effect is negative but not significant for urban residents. Based on the results of Column (2), digital finance's marginal effect on the entrepreneurship of rural residents is 0.00288. That is to say, an increase in the Index of Digital Financial Inclusion by each standard deviation will make it 4.9-6.3 percentage points more likely for rural families to venture into business. This effect is fairly significant.

5.3 Who Benefited the Most from Digital Finance?

We further examine which social group had benefited more from digital finance in terms of the probability of venturing into business to offer a detailed analysis on digital finance's distribution effects and how digital finance contributes to inclusive growth.

5.3.1 Heterogeneity of material capital

Referencing Zhou and Li (2016), we use household net income as a proxy variable of material capital to divide rural households into low-income group (below median) and high-income group (above median) and use Probit model to estimate by samples, and the regression results are shown in Table 6. We find that digital finance only helps increase the chance of low-income group households to venture into business, and the effect is insignificant for high-income group households. One possibility is that the

Table 5: Digital Finance's Heterogeneous Effects on Family Entrepreneurship

Dependent variable (based on whether a household ventures into business)	(1)	(2)	(3)	(4)
	Rural samples		Urban samples	
Index of Digital Financial Inclusion	0.0041**	0.0037*	-0.0026	-0.0017
	(0.0021)	(0.0022)	(0.0017)	(0.0018)
Control variables for household head	No	Yes	Yes	Yes
Control variables for household	No	No	Yes	Yes
Control variables for region	No	No	No	Yes
Spatial fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	11,832	11,832	10,187	10,187
Pseudo R^2	0.0406	0.0737	0.0549	0.0952

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Table 6: Digital Finance and Rural Households' Entrepreneurship: Heterogeneity of Material Capital (household income)

Dependent variable (based on whether a household ventures into business)	(1)	(2)	(3)	(4)
	Low-income group		High-income group	
Index of Digital Financial Inclusion	0.0050*	0.0051*	0.0035	0.0016
	(0.0029)	(0.0030)	(0.0030)	(0.0033)
Control variables for household head	No	Yes	Yes	Yes
Control variables for household	No	No	Yes	Yes
Control variables for region	No	No	No	Yes
Spatial fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	5,825	5,825	5,919	5,919
Pseudo R^2	0.0557	0.104	0.0441	0.0740

latter already has access to funds for doing business, and thus are not highly sensitive to the development of digital finance.

5.3.2 Heterogeneity of Human Capital

Based on the household head's length of education, we divide data into the less educated group (primary school and below) and more educated group (junior middle school and above) to estimate the entrepreneurship model, respectively.[6] Table 7 suggests that digital finance promotes entrepreneurship mainly for the more educated group of rural residents, which makes it not inclusive in nature. Yet this finding is consistent with expectations. After all, it takes certain computer literacy and self-learning capacity for people to use internet-based digital finance. Less educated households also lack the knowledge reserves required for starting a business. Notably, findings in this section underscored the importance of human capital in the era of "mass entrepreneurship."

5.3.3 Heterogeneity of social capital

Referencing Zhou *et al*. (2015) and Zhou and Li (2016), we use households' access to private transfer payment income as the proxy variable for social capital, and thus divide data into two groups. Access to private transfer payment income means that a household is more socially connected and boasts higher social capital. Results of Table 8 suggest that digital finance has made it significantly more likely for the low social capital group to start a business, but the effect is insignificant for the high social capital group. That is to say, digital finance makes rural residents significantly less dependent on social networks.

6. Conclusions

As another major revolution after humankind invented steam engine and harnessed electric power,

[6] Junior middle school is used as the boundary considering the poor level of education among household heads in the countryside. Samples with primary school education and below account for two thirds of the samples. If a higher level of education is used as boundary, the sample size of the more-educated group would be too small.

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Table 7: Digital Finance and Rural Households' Entrepreneurship: Human Capital Heterogeneity

Dependent variable (based on whether a household ventures into business)	(1)	(2)	(3)	(4)
	Low human capital		High human capital	
Index of Digital Financial Inclusion	0.0019	0.0017	0.0063**	0.0056*
	(0.0028)	(0.0030)	(0.0030)	(0.0033)
Control variables for household head	No	Yes	Yes	Yes
Control variables for household	No	No	Yes	Yes
Control variables for region	No	No	No	Yes
Spatial fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	7,446	7,446	4,338	4,338
Pseudo R^2	0.0361	0.0693	0.0518	0.0893

Table 8: Digital Finance and Rural Households' Entrepreneurship: Social Capital Heterogeneity

Dependent variable (based on whether a household ventures into business)	(1)	(2)	(3)	(4)
	Low social capital		High social capital	
Index of Digital Financial Inclusion	0.0058**	0.0061**	-0.0025	-0.0071
	(0.0023)	(0.0024)	(0.0046)	(0.0050)
Control variables for household head	No	Yes	Yes	Yes
Control variables for household	No	No	Yes	Yes
Control variables for region	No	No	No	Yes
Spatial fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	9,225	9,225	2,461	2,461
Pseudo R^2	0.0407	0.0781	0.0813	0.112

the Third Industrial Revolution has enabled resources to be shared on an unprecedented scale, and its impact on income distribution has gradually become more prominent. The internet-based digital economy and digital finance create conditions for addressing income inequalities. Regretfully, the existing body of literature is preoccupied with the growth or efficiency effects of the internet without paying adequate attention to the effects on wealth gaps or inequalities, therefor the role of the internet revolution in economic development is not fully uncovered.

This paper's main contribution is the creation of an empirical framework to evaluate digital finance's effects on inclusive growth in China driven by the internet revolution and digital economy,

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which makes up for the paucity of research on how the digital economy and digital finance contribute to income distribution. After matching the China Digital Inclusive Financial Index and the China Family Panel Studies data, this paper estimates inclusive growth effects of digital finance in China. Our findings suggest that digital finance has boosted household income, particularly for the rural low-income group. Hence, the development of digital finance is conducive to inclusive growth in China. By examining the transmission mechanism of digital finance's inclusive growth effects, this paper finds that digital finance is more helpful for rural rather than urban households to start a business. Lastly, we have conducted a heterogeneity analysis of rural households' material, human and social capital, and find that digital finance makes it more likely for rural low-income and less socially connected households to venture into business, thus helping improve income distribution in the countryside. All our findings demonstrate the inclusive growth effects of digital finance driven by the internet revolution.

The policy implications of our findings are apparent. First, given the importance of digital financial services to increasing rural household income, policymakers should continue advancing the development of digital finance and giving play to its role in promoting entrepreneurship, income growth and fair income distribution. Another priority is to foster human capital for rural residents to reap the benefits of inclusive digital finance. Certainly, an appropriate screening mechanism should be in place to ensure that the limited credit resources are extended to applicants who are the most likely to succeed in starting their business. CE

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