



Can fintech innovation promote household consumption? Evidence from China family panel studies

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ABSTRACT

Using data from the China Family Panel Studies (CFPS) and the digital inclusive financial index (DFI), this paper explores the relationship between fintech innovation and household consumption. The results show that fintech innovation can significantly promote household consumption at the nationwide level. Further mechanism tests show that entrepreneurship and increasing income are the two main transmission channels. Besides that, we further conduct heterogeneity tests. The tests present that the promoting effects in the eastern region, urban households, and wealthy households are higher than that in the western region, rural households, and low- and middle-income groups. The phenomenon shows that the Chinese government should positively guide the development of fintech in order to enable people to enjoy the benefits brought by scientific progress. In addition, the conclusions have great reference value for developing countries.

1. Introduction

Consumption has been playing a crucial role in economic development. In China, for example, the contribution of consumption to the total economic growth has been maintained at more than 50% since 2015. Despite the impact of the COVID-19 epidemic in 2020, China's final consumption accounted for 54.3% of GDP in the whole year according to the data of the National Bureau of Statistics. Consumption is still the "ballast stone" for the stable operation of the economy, and has been the first pulling force of China's economic growth for seven consecutive years.

Actually, there is a wide body of literature on household consumption. In the classical Life-Cycle Hypothesis (LCH), individual consumption depends on one's income, and people seek to smooth consumption throughout their lifetime. In recent years, people keep on pushing the studies on individual consumption. For instance, Kaplan and Violante (2014) develop a structural model, where people could hold two kinds of assets with different liquidity to study the consumption response to income volatilities. There are also some studies providing empirical evidence, like Blundel, Pistaferri, and Preston (2008), Agarwal, Liu, and Souleles (2007), and Baker and Yannellis (2017), etc.

On the other hand, fintech¹ innovation might be playing an important role in promoting consumption. As shown in Fig. 1, the final consumption rate of Chinese residents gradually rose from 49.6% in 2011 to 54.3% in 2020. In the meanwhile, the digital inclusive financial index, which represents the development level of fintech, increased rapidly, from 40% in 2011 to 341.22 in 2020. This phenomenon should not be a coincidence, and there may be some close connection between them.

According to the previous literature, fintech could have a far-reaching impact on people's lives. Demertzis, Merler, and Wolff (2018) propose that fintech innovation can overcome the problem of information asymmetry to a great extent and improve the efficiency of financial resource allocation through big data analysis and processing. It will also bring technological progress and promote enterprise innovation by providing investors with innovative back-end service education and training (Haddad & Hornuf, 2019), so that finance can serve the real economy better, promote economic output, and promote productivity development (Koffi, 2016; Broby, Hoepner, Klausmann, et al., 2018). Besides that, fintech innovation accelerates the substitution of electronic money for traditional currency, provides convenience for consumers to pay, and promotes household consumption in multiple dimensions by reducing payment costs, providing consumer credit, stimulating impulse

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¹ As defined by the FSB, 2016, fintech refers to financial innovation brought about by technology. It can create new business models, applications, processes, thus having a significant impact on the way financial markets. Some scholars believe that the emergence of fintech is the result of the simultaneous collision of institutional, human resources, and market factors (Zavolokina, Dolata, & Schwabe, 2016).

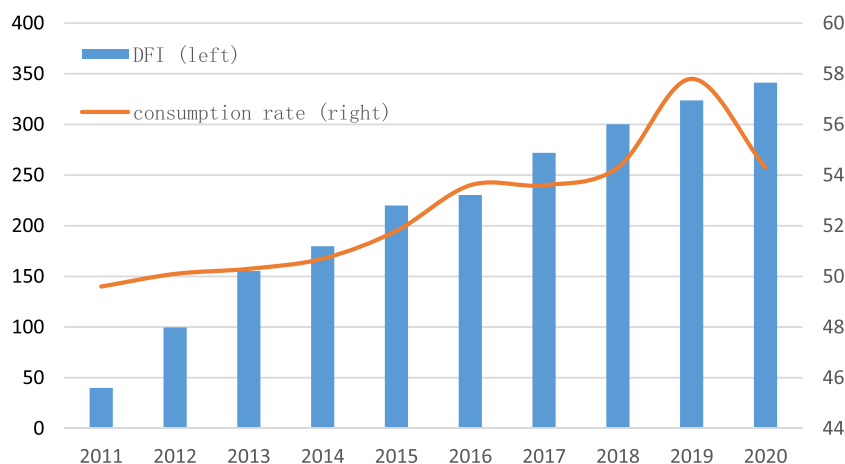


Fig. 1. Chinese consumption rate and Digital inclusive Financial Index.

Note: This figure depicts the changes in the Chinese consumption rate and Digital inclusive Financial Index from 2011 to 2016.

consumption (Beck, Pamuk, Ramrattan, & Uras, 2018; Riley, 2018). Notably, with the COVID-19 sweeping the globe, people change their attitude to the fintech application (Al-Nawayseh, 2020; Le, 2021; Le, Yarovaya, & Nasir, 2021). And empirical.

evidence has shown that fintech does play a positive role during the COVID-19 epidemic (Liu, Pan, & Yin, 2020; Xu, Gao, & Zhang, 2021).

A reasonable question is will fintech promote household consumption? And how does it affect household consumption? A mostly related study is Li, Wu, and Xiao (2020). Using data from the China Household Finance Survey (CHFS), Li et al. (2020) document that fintech would promote household consumption through the mechanisms of online shopping, digital payment, obtainment of online credit, purchase of financing products, and business insurance on the internet. However, as we all know, household consumption mainly depends on its income. And it is necessary to study the change of household income structure caused by fintech application. Therefore, different from the previous study, this paper explores the link between fintech application and household consumption by using data from China Family Panel Studies (CFPS). Compared with CHFS, CFPS includes more basic behavioral characteristics of households rather than financial characteristics, which will be more conducive to our research. By using this data, we further explore whether fintech could inspire entrepreneurship and increase household income.

This paper contributes to the following aspects. First, we study the impact of fintech on household consumption from the perspectives of entrepreneurship and household income, which will enrich the existing research. Second, CFPS data and digital inclusive financial index (DFI) are used to test the impact of fintech on household consumption. The data sources are true and reliable, and the test results are reliable. Moreover, it is appropriate for our research question. Finally, this study examines the heterogeneity of the impact of fintech on household consumption from three aspects: regional differences, urban-rural differences, and wealth differences. In addition, it draws a conclusion that is not the same as the existing research, and the research conclusion is more generally applicable.

The remainder of the paper is structured as follows. Section II provides the literature review and hypotheses. Section III summaries the data and provides the econometric model. Section IV shows the empirical results. And section V concludes the paper.

2. Literature review and hypotheses

2.1. Literature review

The problem of household consumption has been widely concerned,

and related literatures emerge one after another for a long time. There are many factors that affect consumption, such as income and savings, household assets, credit, macroeconomic policies, and so on. Typically, the relationship between consumption inequality and income inequality has aroused widespread concern. It is found that consumption inequality does not increase significantly, which is different from the changing law of income inequality by constructing the consumption model of income risk-sharing and endogenous development of the credit market (Krueger & Perri, 2006). The change of the duration of income shock is the reason for the separation of income inequality and consumption inequality in the United States in the 1980s. Taxation, transfer payment, and household labor supply play an important role in consumption inequality (Blundel et al., 2008). Then the sensitivity of consumption and time allocation to temporary and permanent wage shocks is calculated (Blundell, Pistaferri, & Saporta-Eksten, 2018). Other studies have found that the change in consumption is more stable than the change in income, so it can reflect economic inequality more accurately (Blundell & Preston, 1998; Zimmerman & Carter, 2003; Krueger & Perri, 2006; Meyer & Sullivan, 2013). However, some studies have shown that the measure of consumption inequality can only reflect household-level inequality (Lise & Seitz, 2011), and the relationship between consumption inequality and income inequality is closer than that estimated by the direct response to expenditure (Aguar & Bils, 2015). The cost of portfolio adjustment will be an important factor affecting the impact of consumption on income (Bonaparte, Cooper, & Zhu, 2012). Empirical research shows that loosening consumer credit will increase liquidity and thus increase consumer demand (Ludvigson, 1999). Macroeconomic policies such as fiscal policy, tax policy, industrial policy, government consumption, and investment will also affect household consumption, and show different effects in different groups, regions, and policy implementation stages. The study found that the shock of government spending during the recession indicates an increase in productivity, and the continued growth in government investment leads to an increase in consumption, which is reflected in increased confidence (Bachmann & Sims, 2012). Besides, studies have shown that aging, labor supply, life cycle, well-being will affect consumption, social security, especially retirement and other major changes in work status, intend to have an impact on the total amount and structure of consumption (Blundel et al., 2008; Yang & Ching, 2014; Blundell et al., 2018).

As a kind of technological innovation, fintech has greatly promoted the technological progress, enterprise transformation, and consumption upgrading of enterprises. In addition, it is found that fintech can promote household consumption, while online shopping, electronic payment, and online lending are the intermediary variables of fintech to promote consumption (Li et al., 2020). Other studies have shown that

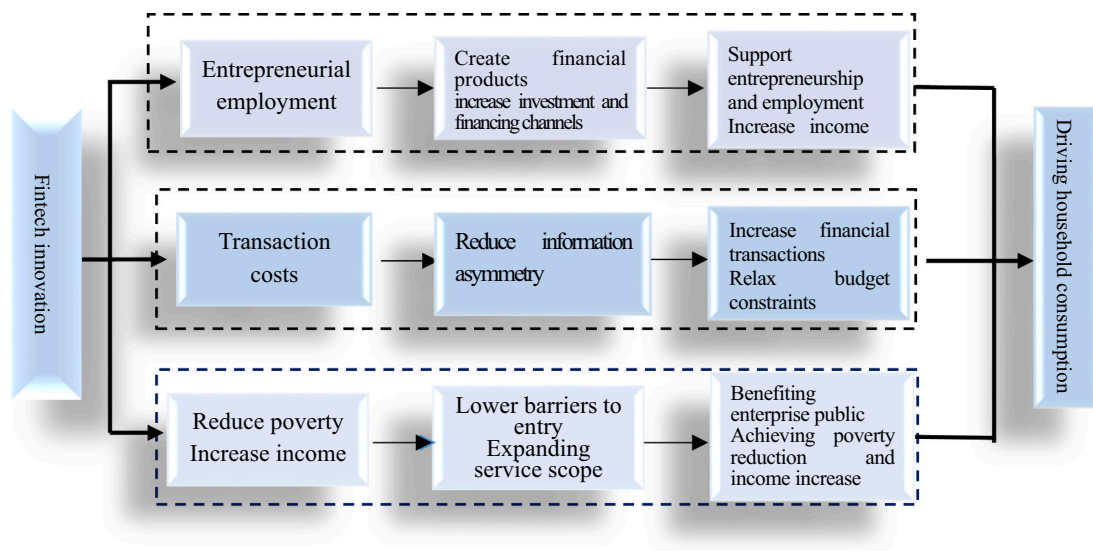


Fig. 2. Influence mechanism of fintech innovation on household consumption.
 Note: This figure depicts the influence mechanism of fintech on household consumption.

Table 1
 Descriptive statistics.

Variable name	Variable code	Sample	Mean value	Standard deviation	Minimum value	Maximum value
Household consumption (logarithm)	hce	34,269	10.41	0.91	3.74	15.34
Fintech Index	fintech	34,269	1.64	0.91	0.19	3.37
Family size	size	34,269	3.85	1.71	1.00	10.00
Age	age	34,269	48.26	12.35	18.00	75.00
Gender	gender	34,269	0.55	0.50	0.00	1.00
Marital status	marriage	34,269	0.88	0.33	0.00	1.00
Degree	education	34,269	2.70	1.32	1.00	8.00
Household registration type	hukou	34,269	0.75	0.44	0.00	1.00
Working condition	employ	34,269	0.87	0.34	0.00	1.00
Health condition	health	34,269	3.15	1.21	1.00	5.00
Cash stock	cash	34,269	6.71	4.57	0.00	15.76

Note: This table shows summary statistics for the key variables in this study.

fintech has a negative effect on household consumption smoothness, and this negative effect still exists when focusing on coverage breadth and depth index respectively (Lai, Yan, Yi, & Zhang, 2020). Fintech innovation subverts the traditional way of allocating financial resources based on bank indirect financing, which poses a great challenge to the traditional financial industry (Bunea, Kogan, & Stolin, 2016). Fintech innovation will also spur the rise of regulatory arbitrage and shadow banking, where fintech lenders serve more creditworthy borrowers and are more active in the refinancing market than other shadow banks, which brings challenges to the traditional financial industry (Buchak, Matvos, Piskorski, & Seru, 2018). However, some scholars believe that the traditional financial industry can also use fintech to turn crises into opportunities because the innovation of the integration of science and technology and finance will produce a multiplier effect, which will help to promote economic output and promote the development of productive forces (Broby et al., 2018; Koffi, 2016). It is also found that the technological innovation based on fintech can not only solve the trust problem of both sides of the transaction and effectively improve the transaction efficiency, but also overcome the problem of information asymmetry to a great extent through big data analysis and processing to improve the efficiency of financial resource allocation (Demertzis et al., 2018; Heiskanen, 2017). Moreover, fintech brings technological progress by providing innovative back-office services, education, and training to investors (Haddad & Hornuf, 2019). Other scholars use the theory of transaction cost economics and blockchain technology to put forward a model to demonstrate how to use blockchain technology to

overcome many problems in venture financing (Ahluwalia, Mahto, & Guerrero, 2020).

As one of the main innovative modes of fintech, electronic payment has attracted more and more attention to its impact on household consumption. However, there is still a big dispute as to whether fintech and electronic payment can promote household consumption. Most scholars believe that electronic payment will promote household consumption. When electronic payment helps to make shopping more convenient and efficient, it is easier for people to get consumer credit, get more financial resources and actively participate in the digital economy, make transactions more secure and transparent, strengthen mutual trust between transactions and promote consumption (Zandi, Singh, & Irving, 2016). Other studies have shown that mobile money has an important impact on corporate growth, consumption, and macroeconomic development (Beck et al., 2018). Studies on mobile payments in developing countries have shown that mobile payment users can prevent a decline in consumption under the impact of natural disasters (Riley, 2018). In addition, studies have shown that there is obvious heterogeneity in the impact of fintech, electronic payment, and e-commerce on consumption. The purpose of this study is to explore the impact of reducing transaction costs on risk-sharing by estimating the impact of mobile money on consumption. The study found that although the shock reduced non-user consumption by 7%, consumer household consumption was not affected (Jack & Suri, 2014). Digital inclusive finance can promote household consumption, mainly promoting household recurrent expenditure on clothing, food, housing, transportation, medical care, education, and

Table 2
Benchmark regression results.

Variable	(1) Full sample	(2) Balance panel
fintech	0.250*** (2.91)	0.358*** (3.05)
cash	0.003*** (3.03)	0.004*** (2.82)
size	0.122*** (25.28)	0.118*** (17.93)
age	-0.015*** (-20.88)	-0.016*** (-16.16)
gender	0.038*** (3.18)	0.044*** (2.88)
marriage	0.179*** (7.78)	0.171*** (5.26)
education	0.054*** (7.33)	0.047*** (4.82)
hukou	-0.095*** (-3.68)	-0.120*** (-3.50)
health	0.014*** (3.22)	0.015** (2.47)
employ	0.011 (0.65)	0.016 (0.69)
Constant	10.217*** (79.60)	10.182*** (59.76)
Number of samples	34,269	16,756
R-squared	0.171	0.171
Number of individuals	12,490	4189
Individual fixed effect	YES	YES
Provincial fixed effect	YES	YES
Year fixed effect	YES	YES

Note: This table shows the regression results of [formula \(1\)](#). Column (1) shows the regression results of the full sample, and column shows the regression results of the balance panel sample. T-statistics values are in parentheses. ***, **, and * represent two-tailed significance at the 1%, 5%, and 10% levels respectively.

entertainment, and in third-and fourth-tier cities, digital finance plays a greater role in promoting consumption than other families in families with fewer assets, low income and poor financial literacy ([Li et al., 2020](#)).

From an academic perspective, mobile payment and financial technology can both be classified into the category of the digital economy. As defined by [Goldfarb and Tucker \(2019\)](#), the digital economy is based on the digital technology which is the representation of information in bits. People can reduce the cost of storage, computation, and transmission of data. Given the characteristic of the digital economy, researchers pay more attention to its impact on traditional economic activities. From the perspective of research objects, the current literature can be divided into two strands. The first one emphasizes the macro impact of the digital economy. In contrast, other researchers pay more attention to its micro impact, such as the impact of the digital economy on corporate behaviors and individual behaviors. Specifically, from the macro perspective, some economists modify the classical macro growth model. Since a large amount of data will be generated in the production activities of enterprises, these data can react to the production activities of enterprises. Based on this consideration, some researchers apply the data generated in enterprise activities to the classical growth model to study the impact of the digital economy on economic growth. The representative literatures are [Jones and Tonetti \(2020\)](#), etc. By comparison, some scholars have shown great enthusiasm for the micro impact of the digital economy. With the wake of the information age, more data will be produced in the process of production, shopping, payments, etc. Therefore, some economists further explore its micro impact. For instance, [Begenau, Farboodi, and Veldkamp \(2018\)](#) point out that data is one of the important reasons for the increase of enterprise scale. [Farboodi and Veldkamp \(2020\)](#) study the impact of data on individual investment behavior. Among all the existing literature, the most relevant one is the literature on relationship between digital economy and household

Table 3
Results of system GMM estimation.

Variable	(1) Full sample	(2) Balance panel
L.hce	0.151*** (4.20)	0.185*** (6.16)
L2.hce	0.038 (1.59)	0.054** (2.55)
fintech	0.324*** (10.19)	0.321*** (10.24)
cash	0.003 (1.25)	0.003 (1.27)
size	0.155*** (13.79)	0.152*** (13.43)
age	-0.018*** (-10.43)	-0.019*** (-10.91)
gender	0.057** (1.97)	0.059** (2.02)
marriage	-0.039 (-1.20)	-0.046 (-1.41)
education	0.070*** (3.97)	0.069*** (3.94)
hukou	0.094*** (3.42)	0.096*** (3.47)
health	0.026** (2.46)	0.027*** (2.61)
employ	-0.003 (-0.11)	-0.009 (-0.38)
Constant	7.836*** (13.23)	7.601*** (16.39)
Observations	10,578	9248
Number of fid10	6257	4927
Individual FE	YES	YES
Province FE	YES	YES
The validity of instruments tests		
Sargan test of overid. restrictions:	chi2 = 2.25 Prob > chi2 = 0.134	chi2 = 2.39 Prob > chi2 = 0.122
Hansen test of overid. Restrictions:	chi2 = 2.05 Prob > chi2 = 0.152	chi2 = 10.06 Prob > chi2 = 0.002

Note: This table shows the regression results after using system GMM estimation. Column (1) shows the regression results of the full sample, and column shows the regression results of the balance panel sample. T-statistics values are in parentheses. ***, **, and * represent two-tailed significance at the 1%, 5%, and 10% levels respectively.

consumption behaviors. For example, [Jack and Suri \(2014\)](#) use the quasi-natural experiments from Kenya to study the impact of mobile payment on consumption smoothing. [Li et al. \(2020\)](#) explores the link between digital finance and household consumption by using the data from China. Compared with these previous literatures, this paper puts more emphasis on the impact of digital economy on residents' entrepreneurial behavior. Specifically, we suppose that the digital economy can promote residents' entrepreneurship, increase their income, and further improve their consumption level. In addition, this paper also adopts a new database for empirical tests. All the contents constitute the main features of this paper.

2.2. Relevant hypotheses

The development of fintech could provide more financial products and services, lower transaction costs, and improve transaction efficiency. Fintech will benefit more and more people and even medium-sized enterprises. That will finally increase the income of residents, expand household consumption, and promote economic growth. Given this, this paper proposes that the mechanisms of fintech impact household consumption will include at least three channels, as shown in [Fig. 2](#).

Fintech combines both advantages of technology and finance. It creates new financial services to finance medium-sized enterprises. From the perspective of entrepreneurship and employment mechanism, fintech innovation could encourage entrepreneurship and employment.

Table 4
Additional test I (2012–2016).

Variable	(1) Full sample	(2) Balance panel	(3) Full sample	(4) Balance panel
fintech	1.061*** (46.34)	0.976*** (38.42)	1.478*** (3.89)	0.856* (1.86)
cash	0.001*** (4.15)	0.001*** (4.31)	0.015*** (3.57)	0.013*** (2.84)
size	-0.002* (-1.84)	-0.002** (-2.13)	-0.058*** (-4.12)	-0.059*** (-3.80)
age	0.000 (0.99)	0.000 (0.73)	-0.002 (-0.77)	-0.003 (-1.08)
gender	-0.001 (-0.29)	0.001 (0.31)	-0.043 (-1.04)	-0.050 (-1.10)
marriage	0.000 (0.05)	0.003 (0.91)	-0.026 (-0.78)	-0.080** (-2.07)
education	0.004** (2.12)	0.003 (1.47)	-0.032 (-1.28)	-0.034 (-1.24)
hukou	-0.004 (-1.15)	-0.010** (-2.21)	-0.028 (-0.70)	-0.062 (-1.38)
health	0.003** (2.49)	0.003** (2.53)	0.010 (0.65)	0.013 (0.75)
employ	-0.001 (-0.97)	-0.001 (-1.35)	-0.104*** (-7.17)	-0.104*** (-6.15)
Constant	2.770*** (47.93)	2.839*** (45.22)	106.414*** (235.63)	107.223*** (200.35)
Number of samples	29,257	19,558	29,257	19,558
R-squared	0.888	0.890	0.231	0.243
Number of individuals	12,981	6527	12,981	6527
Individual fixed effect	YES	YES	YES	YES
Provincial fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES

Note: This table shows the robustness test of changing data sources and explained variables. In columns (1) and (2), the explained variable is household consumption level. In columns (3) and (4), the explained variable is the household consumption index. The time period is from 2012 to 2016. T-statistics values are in parentheses. ***, **, and * represent two-tailed significance at the 1%, 5%, and 10% levels respectively.

By these mechanisms, fintech will promote household consumption and even economic growth. Some scholars put forward a model by combining transaction cost economics theory and blockchain technology to demonstrate how to use blockchain technology to overcome many problems existing in start-up financing (Ahluwalia et al., 2020). The rapid development of fintech will improve the quality and efficiency of banking services by changing traditional financial services (Berger, 2003; Cortina Lorente & Schmukler, 2018). Studies show that risk assessment using big data technology can reduce transaction costs and information asymmetry, thus increasing the availability of financing for small and micro enterprises and supporting entrepreneurship (Moenninghoff & Wieandt, 2013). Studies have found that mobile payment helps to improve entrepreneurial execution and reduce information asymmetry, thus improving entrepreneurial performance (Beck et al., 2018). The improvement of the overall level of fintech will not only promote entrepreneurship and employment but also promote household consumption and narrow the urban-rural consumption gap by increasing income (Amer, Buckley, Zetzsche, et al., 2020). Therefore, this paper proposes hypothesis 1:

H1. Fintech could affect household consumption through the mechanisms of entrepreneurship and employment.

Table 5
Additional test II (2012–2018).

Variable	(1) Full sample	(2) Balance panel	(3) Full sample	(4) Balance panel
fintech	1.253*** (53.00)	1.087*** (35.76)	8.982*** (31.64)	7.613*** (15.03)
cash	0.001*** (4.62)	0.001*** (3.03)	0.014*** (3.63)	0.021*** (2.77)
size	-0.000 (-0.36)	-0.000 (-0.45)	-0.023* (-1.79)	-0.022 (-0.90)
age	0.000* (1.93)	0.000 (1.48)	0.000 (0.01)	0.000 (0.01)
gender	0.001 (0.21)	-0.001 (-0.29)	-0.061 (-1.64)	0.031 (0.45)
marriage	-0.000 (-0.00)	0.003 (0.90)	0.005 (0.16)	0.023 (0.44)
education	0.007*** (4.20)	0.006*** (3.19)	-0.021 (-0.99)	-0.080* (-1.94)
hukou	-0.005 (-1.57)	-0.008** (-2.23)	-0.000 (-0.01)	0.054 (0.73)
health	0.002** (2.44)	0.003** (2.07)	0.025* (1.72)	0.032 (1.10)
employ	0.000 (0.01)	-0.001 (-0.44)	-0.120*** (-9.44)	-0.141*** (-5.81)
Constant	2.853*** (61.17)	3.011*** (52.91)	99.038*** (295.06)	100.434*** (159.45)
Number of samples	37,661	21,507	37,661	9488
R-squared	0.904	0.910	0.210	0.193
Number of individuals	13,146	5381	13,146	3167
Individual fixed effect	YES	YES	YES	YES
Provincial fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES

Note: In columns (1) and (2), the explained variable is household consumption level. In columns (3) and (4), the explained variable is the household consumption index. The time period is from 2012 to 2018. T-statistics values are in parentheses. ***, **, and * represent two-tailed significance at the 1%, 5%, and 10% levels respectively.

From the perspective of the transaction cost mechanism, fintech can reduce information asymmetry. Specifically, fintech will expand the application fields of information, makeup information gap, and form information value finally. Besides that, fintech will reduce transaction costs, increase financial transactions, obtain financing support or investment income, relax budget constraints, increase consumption budget, and drive household consumption. Technological innovation based on fintech cannot only effectively improve transaction efficiency, but also minimize information asymmetry. Finally, it will reduce transaction costs and improve the efficiency of financial resource allocation (Demertzis et al., 2018; Heiskanen, 2017). Therefore, we propose hypothesis 2:

H2. Fintech could affect household consumption by reducing transaction costs and financing constraints.

From the perspective of poverty reduction and income increase mechanisms, fintech can increase residents' income, reduce poverty rate, reduce income inequality and narrow the gap between urban and rural areas (Sarma & Pais, 2011; Anand & Chhikara, 2013). Studies have found that fintech can help Kenyan farmers through two channels: payment facilitation and smooth consumption (Grossman & Tarazi, 2014). Some scholars have discussed the inclusion of fintech. It believes that fintech has a positive impact on financial inclusion and stability

Table 6
Transmission mechanism test.

Variable	(1)	(2)	(3)	(4)
	Full sample	Balance panel	Full sample	Balance panel
DFI	0.246*** (2.85)	0.313*** (2.66)	-0.525*** (-5.00)	-0.476*** (-3.45)
entrepre	0.189*** (6.12)	0.148*** (3.79)		
fintech*entrepre	0.031** (2.20)	0.043** (2.39)		
income			0.038*** (4.71)	0.032*** (2.96)
fintech*income			0.053*** (11.64)	0.059*** (9.26)
cash	0.004*** (3.12)	0.005*** (3.12)	-0.001 (-0.45)	0.000 (0.15)
size	0.128*** (27.57)	0.126*** (20.25)	0.106*** (22.65)	0.104*** (16.78)
age	-0.014*** (-20.20)	-0.014*** (-15.05)	-0.013*** (-19.04)	-0.013*** (-14.02)
gender	0.041*** (3.49)	0.042*** (2.74)	0.037*** (3.14)	0.035** (2.33)
marriage	-0.035*** (-3.29)	-0.024 (-1.51)	-0.028*** (-2.71)	-0.016 (-1.07)
education	0.046*** (6.26)	0.047*** (4.85)	0.036*** (4.91)	0.038*** (4.04)
hukou	0.047*** (3.85)	0.062*** (3.81)	0.039*** (3.28)	0.053*** (3.43)
health	0.015*** (3.39)	0.016*** (2.82)	0.014*** (3.19)	0.013** (2.35)
employ	-0.001 (-0.20)	-0.004 (-0.72)	-0.003 (-0.70)	-0.006 (-1.13)
Constant	10.238*** (79.58)	10.158*** (60.01)	10.124*** (65.58)	10.076*** (50.25)
Number of samples	35,098	17,276	34,785	17,106
R-squared	0.178	0.174	0.201	0.197
Number of individuals	12,820	4319	12,808	4319
Individual fixed effect	YES	YES	YES	YES
Provincial fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES

Note: This table shows the results of transmission mechanism test. T-statistics values are in parentheses. ***, **, and * represent two tailed significance at the 1%, 5%, and 10% level respectively.

(Ozili, 2018). In addition, digital inclusive finance can also indirectly reduce the poverty of residents by improving income distribution, while lack of access to financial services may lead to income inequality and even make residents fall into the poverty trap (Aghion & Bolton, 1997). Therefore, we propose hypothesis 3:

H3. Fintech could affect influence household consumption by reducing poverty and increasing income.

3. Research design

3.1. Data

The data used in this study was obtained from the China Family Panel Studies (CFPS). The CFPS was carried out by the China Social Science Research Center of Peking University, has been released biennially since 2010 to reflect the changes in China's social economy by tracking and collecting data at the individual, family, and community levels. CFPS covers 16,000 households from 25 provinces in China and

includes all members of the sample families. As a consequence, CFPS has national representativeness and high reliability. In this study, the explained variables, the family characteristic variables, and the household characteristic variables all come from the database.

We also used data from China's Digital Inclusive Financial Index (DFI). The DFI was carried out by the digital finance Research Center of Peking University and Ant Financial Services Group from 2011 to 2020. A total of 33 specific indicators are selected from the three aspects of coverage breadth, depth of use, and degree of digitization in DFI, which has good representativeness and high reliability. The coverage breadth is mainly reflected by the number of electronic accounts (such as Internet payment accounts and the number of bank accounts bound to them), which is explained by account coverage indicators. The depth of use is measured by the actual use of Internet financial services, including payment services, money fund services, insurance services, investment services, and credit services. Convenience and cost are the main factors affecting users' use of financial services. The degree of digitization includes four dimensions: liquidity, materialization, credit, and facilitation.

3.2. Variables

3.2.1. Explained variable

The explained variable in this study is household consumption (*hce*). It consists of expenditure on clothing, food, housing, transportation and communications, household equipment and daily necessities, medical and health care, culture, education and entertainment, and other expenses. They are all included in household consumption.

3.2.2. Core explanatory variable

The core explanatory variable is fintech. In this paper, we adopt the digital inclusive financial index (DFI) to represent fintech. It includes coverage breadth index, usage depth index, and digitization index. In this study, the "China Digital Inclusive Financial Index" is used to represent the fintech index. The compilation of China's digital inclusive financial index is more scientific and reliable, and its index selection better reflects the innovative development of fintech. Therefore, the digital inclusive financial index can better represent the fintech index.

3.2.3. Control variables

The control variables used in this study include family characteristic variables and head of household characteristic variables. The main variables include: (1) Family characteristic variables, including family population size (*size*), household registration category (*hukou*), cash stock (*cash*); (2) the characteristic variable of the head of household, taking the head of household as the family agent, selects the variables that have potential influence on the family income and consumption decision-making behavior and consumption level, including gender, age, marital status, highest educational background, whether to work, health status and so on.

3.3. Econometric model

Firstly, we establish the following econometric model in order to test the relationship between fintech and household consumption.

$$hce_{it} = \alpha_0 + \alpha_1 fintech_{j,t-1} + \alpha_2 X_{it} + \theta_i + \varphi_j + \eta_t + \varepsilon_{it} \quad (1)$$

In the formula (1), hce_{it} represents the consumption expenditure of households in t year, and $fintech_{j,t-1}$ represents the level of fintech development in the province where the family is located. In order to

Table 7
Regional heterogeneity test.

Variable	(1) Eastern (full sample)	(2) Middle (full sample)	(3) Western (full sample)	(4) East (balance panel)	(5) Middle (balance panel)	(6) West (balance panel)
fintech	0.347*** (2.99)	0.226 (1.01)	0.167 (0.53)	0.468*** (2.86)	0.226 (0.79)	0.158 (0.37)
cash	0.005*** (2.81)	-0.000 (-0.05)	0.004** (2.08)	0.006*** (2.68)	-0.001 (-0.22)	0.006** (2.24)
size	0.132*** (16.22)	0.134*** (17.18)	0.123*** (14.46)	0.126*** (11.30)	0.128*** (12.26)	0.127*** (11.31)
age	-0.015*** (-13.22)	-0.013*** (-9.54)	-0.015*** (-11.67)	-0.017*** (-11.26)	-0.013*** (-6.82)	-0.014*** (-8.02)
gender	0.041** (2.26)	0.045** (2.02)	0.060** (2.53)	0.057** (2.42)	0.060** (2.07)	0.041 (1.37)
marriage	-0.024 (-1.37)	-0.068*** (-3.34)	-0.021 (-1.13)	-0.011 (-0.47)	-0.089*** (-2.86)	0.013 (0.52)
education	0.049*** (4.11)	0.043*** (3.10)	0.040*** (2.89)	0.045*** (2.88)	0.048*** (2.58)	0.042** (2.37)
hukou	0.063*** (3.39)	0.015 (0.61)	0.030 (1.27)	0.078*** (3.14)	0.018 (0.56)	0.044 (1.53)
health	0.022*** (3.17)	0.009 (1.08)	0.012 (1.47)	0.015 (1.64)	0.011 (1.03)	0.016 (1.54)
employ	-0.001 (-0.23)	0.012* (1.73)	-0.018** (-2.26)	0.002 (0.18)	0.002 (0.23)	-0.018* (-1.65)
Constant	10.467*** (38.04)	9.616*** (57.59)	9.491*** (18.51)	10.369*** (36.84)	10.176*** (54.57)	10.072*** (52.39)
Number of samples	14,508	10,318	10,272	6711	5104	5461
R-squared	0.178	0.179	0.140	0.182	0.169	0.128
Number of individuals	5768	3826	3606	1794	1324	1396
Individual fixed effect	YES	YES	YES	YES	YES	YES
Provincial fixed effect	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES

Note: This table shows the regression results of the regional heterogeneity test. Columns (1)–(3) use full sample data and columns (4)–(6) use balanced panel data. T-statistics values are in parentheses. ***, **, and * represent two-tailed significance at the 1%, 5%, and 10% levels respectively.

alleviate the endogeneity between variables, the index is delayed by one period. X_{it} represents the characteristics of the head of household, the characteristics of the family and the control variables of the province where the family is located, θ_i presents household fixed effect, η_t presents year fixed effect, φ_j presents province virtual variable, and α is the variable coefficient, α_1 represents the overall impact of fintech innovation and development on household consumption, and ε_{it} represents random disturbance.

Secondly, establishment of the model of transmission mechanism, influence mechanism, and theoretical analysis show that digital financial innovation can form inclusive value through a comprehensive play of inclusive effect, effectively support the capital demand of enterprise innovation and family entrepreneurship, promote innovation and entrepreneurship, increase employment, increase residents' income, expand residents' consumption and promote economic growth. In order to test the influence mechanism of theoretical analysis, this paper constructs the following econometric model to analyze how digital financial innovation is transmitted to residents' consumption through affecting entrepreneurship and residents' income.

$$\begin{aligned}
 hce_{it} = & \tau_0 + \tau_1 DFI_{j,t-1} + \tau_2 \text{entrepre}_{it} + \tau_3 DFI_{j,t-1} \times \text{entrepre}_{it} + \tau_4 X_{it} + \theta_i \\
 & + \varphi_j + \eta_t + \varepsilon_{it}
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 hce_{it} = & \kappa_0 + \kappa_1 DFI_{j,t-1} + \kappa_2 \text{income}_{it} + \kappa_3 DFI_{j,t-1} \times \text{income}_{it} + \kappa_4 X_{it} + \theta_i + \varphi_j \\
 & + \eta_t + \varepsilon_{it}
 \end{aligned} \tag{3}$$

In the formula (2), $DFI_{j,t-1} \times \text{entrepre}_{it}$ is interaction for fintech and home entrepreneurship. In the formula (2), $DFI_{j,t-1} \times \text{income}_{it}$ is the

interaction term between fintech and household income.

4. Empirical results

4.1. Descriptive statistics

The descriptive statistical results of the main variables are shown in Table 1. The maximum, minimum, and standard deviation of Household consumption are 15.34, 3.74, and 0.91, respectively, indicating that the consumption of different households is quite different. The maximum value of the Fintech Index is 3.37, the minimum value is 0.19, and the standard deviation is 0.91, indicating that there is an imbalance in the development of Fintech in different regions, and the level of Fintech development in some regions is relatively low. In addition, the descriptive statistics of the control variables are basically similar to the existing research, we will not discuss them in this paper.

We will carry out benchmark regression, endogeneity test, robust test and heterogeneity test according to the econometric model design.

4.2. Benchmark regression

This part carries on the panel regression according to formula (1). In addition, it controls the triple fixed effect of individual, province, and year. In order to reduce the possibility of reverse causality and alleviate the endogeneity between variables, the development level of the core explanatory variable fintech lags behind by one period. We further control the characteristics of the head of household, the characteristics of the family, and the economic and financial characteristics of the province where the family is located. The relationship between the development of fintech and household consumption was examined.

Table 8
Heterogeneity test between urban and rural areas.

Variable	(1)	(2)	(3)	(4)
	Urban (full sample))	Rural areas (full sample)	Urban (balance panel)	Rural areas (balance panel)
fintech	0.245** (2.11)	0.148 (1.08)	0.297* (1.87)	0.207 (1.17)
cash	0.005*** (2.81)	0.002 (1.10)	0.006*** (2.74)	0.003 (1.32)
size	0.148*** (18.61)	0.121*** (19.52)	0.138*** (12.22)	0.121*** (14.83)
age	-0.012*** (-10.25)	-0.014*** (-14.19)	-0.011*** (-7.07)	-0.014*** (-10.61)
gender	0.041** (2.32)	0.050*** (2.91)	0.042* (1.77)	0.051** (2.38)
marriage	-0.030* (-1.81)	-0.045*** (-3.03)	-0.041* (-1.72)	-0.027 (-1.26)
education	0.034*** (2.97)	0.033*** (2.94)	0.016 (1.04)	0.044*** (3.06)
hukou	0.042** (2.52)	0.021 (1.06)	0.052** (2.24)	0.044* (1.78)
health	0.008 (1.16)	0.016*** (2.78)	0.007 (0.70)	0.018** (2.46)
employ	-0.010 (-1.58)	-0.002 (-0.44)	-0.007 (-0.81)	-0.007 (-0.91)
Constant	10.382*** (52.76)	9.828*** (32.87)	10.413*** (40.70)	9.860*** (28.57)
Number of samples	15,972	19,126	6879	10,397
R-squared	0.206	0.120	0.196	0.116
Number of individuals	7065	7099	2120	2916
Individual fixed effect	YES	YES	YES	YES
Provincial fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES

Note: This table shows the regression results of the heterogeneity test between urban and rural areas. T-statistics values are in parentheses. ***, **, and * represent two-tailed significance at the 1%, 5%, and 10% levels respectively.

It can be seen in Table 2 the test results of the basic model. Column (1) reports the results when all samples are used and the data type is an unbalanced panel. Column (2) reports the results when a partial sample is used and the data type is balanced panel. The core explanatory variable is the lagging fintech index. As can be seen from Table 2, after controlling the individual fixed effect, the provincial fixed effect and the year fixed effect, when using the balance panel and the unbalanced panel respectively, the positive and negative sign and significance of the coefficient remain unchanged. In other words, they all remain positive and significant at the 1% level. This shows that fintech has a significant promoting effect on household consumption.

4.3. Endogeneity test and other additional tests

4.3.1. Endogeneity test

Although we are confident in our conclusion, we cannot completely avoid the endogeneity problems. There might be reverse causal questions. Specifically, in this paper, the higher household consumption, the better the development of fintech might be. Given this, we lag the core explanatory variable by one period to alleviate the endogeneity. Moreover, in order to strengthen the robustness of the results, we conduct further tests. Considering that we use panel data, we choose the GMM

method which is commonly used to alleviate the problem of endogeneity. Table 3 reports the results of the endogenous test using the system GMM method including the validity of instruments tests. Column (1) uses full sample data and column (2) uses balanced panel data. Under the two sample types, the core explanatory variable fintech index is significantly positive at the 1% level. It indicates that the endogenous problem is overcome to a great extent through the lag processing of variables and the use of the system GMM method. Furthermore, we cannot reject the H_0 that the instruments are valid as shown in Table 3.

4.3.2. Additional tests

This study further changes the data sources and the explained variables in order to ensure the robustness of the conclusion. Specifically, this study uses the household consumption level and household consumption index from CSMAR to replace the explained variable household consumption expenditure to test whether the model is robust. Limited by the availability of data, the current CSMAR published household consumption levels and consumer expenditure data are at the provincial level, and the time is up to 2017. In order to take into account, the integrity of the data and the rigor of the research, this study first uses the original data from 2012 to 2016 to test. As a consequence, this study further uses 2017 data instead of 2018 data for robustness tests by considering that the core explanatory variables are lagging behind. The test results are shown in Tables 4 and 5. (See Table 6.)

Table 4 reports the results of the test using 2012–2016 data. Columns (1) and (2) use full sample data and balance panel data respectively and use the household consumption level of CSMAR as the explanatory variable. The results show that the core explanatory variable fintech coefficient is significantly positive at the 1% level. Column (3) uses full sample data and uses the household consumption index in CSMAR as the explained variable. The results show that the fintech coefficient of the core explanatory variable is significantly positive at the 1% level. Similarly, column (4) also uses the household consumption index as the explained variable. However, by using the balance panel data, the coefficient of the variable fintech is also significantly positive at the 10% level.

Table 5 reports the results of the test using 2017 data instead of 2018 data. Columns (1) and (2) use full sample data and balanced panel data respectively, and the explained variable is consumption level. Columns (3) and (4) also use full sample data and balanced panel data, respectively, and the explained variable is the consumption index. The coefficient of the core explanatory variable fintech is significantly positive at the 1% level. Generally speaking, the results of the robustness test are basically consistent with the above, indicating that the model is robust. It also further shows that the innovation and development of fintech have indeed significantly promoted the household consumption of Chinese residents on the whole.

4.4. Transmission mechanism test

According to Eqs. (2) and (3), we will test the entrepreneurial transmission mechanism and income transmission mechanism of the impact of fintech innovation on household consumption respectively. Based on the benchmark model Formula (1), the interaction terms of family entrepreneurship $entrepre_{it}$ and fintech and entrepreneurship interactions $DFI_{j,t-1} \times entrepre_{it}$ to build model Formula (2). The test results of Formula (2) will be used to analyze the mechanism of how fintech innovation influences entrepreneurship to residents' consumption, that is, how fintech innovation promotes entrepreneurship, increases employment and income, and ultimately affects residents' consumption by providing financial products and investment and

Table 9
Wealth heterogeneity test.

Variable	(1) Affluence (full sample)	(2) Medium (full sample)	(3) Aggressive (full sample)	(4) Affluence (balance panel)	(5) Medium (balance panel)	(6) Aggressive (balance panel)
fintech	0.282* (1.91)	0.078 (0.55)	0.130 (0.64)	0.476** (2.50)	0.126 (0.77)	0.051 (0.20)
cash	0.007*** (2.81)	-0.000 (-0.30)	0.006*** (2.90)	0.001 (0.39)	-0.001 (-0.41)	0.011*** (4.10)
size	0.131*** (13.42)	0.122*** (17.25)	0.139*** (16.64)	0.135*** (11.11)	0.118*** (14.37)	0.136*** (12.92)
age	-0.012*** (-8.16)	-0.013*** (-12.56)	-0.019*** (-14.27)	-0.014*** (-7.03)	-0.014*** (-11.25)	-0.018*** (-10.97)
gender	0.047* (1.94)	0.031* (1.91)	0.067*** (2.70)	0.048 (1.55)	0.035* (1.82)	0.057* (1.86)
marriage	-0.011 (-0.50)	-0.028* (-1.71)	-0.049*** (-2.60)	-0.021 (-0.71)	-0.013 (-0.61)	-0.028 (-1.13)
education	0.050*** (3.21)	0.049*** (4.66)	0.033** (2.21)	0.040** (1.99)	0.049*** (3.89)	0.036** (1.99)
hukou	0.057** (2.29)	0.023 (1.30)	0.072*** (2.96)	0.054* (1.76)	0.041* (1.94)	0.077** (2.53)
health	0.011 (1.13)	0.013** (1.99)	0.019** (2.35)	0.006 (0.51)	0.012 (1.64)	0.025** (2.51)
employ	-0.010 (-1.11)	-0.008 (-1.40)	-0.001 (-0.17)	-0.009 (-0.79)	-0.008 (-1.02)	-0.006 (-0.67)
Constant	10.359*** (38.41)	10.498*** (50.51)	10.252*** (39.89)	10.600*** (33.36)	10.441*** (42.38)	10.226*** (33.25)
Number of samples	7134	15,929	9727	3843	10,561	5918
R-squared	0.235	0.171	0.164	0.234	0.168	0.161
Number of individuals	2671	5255	3314	1031	2791	1559
Individual fixed effect	YES	YES	YES	YES	YES	YES
Provincial fixed effect	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES

Note: This table shows the regression results of the family wealth heterogeneity test. Columns (1)–(3) use full sample data, and column (4)–(6) use balanced panel data. T-statistics values are in parentheses. ***, **, and * represent two-tailed significance at the 1%, 5%, and 10% levels respectively.

financing services to families or individuals and small and micro-enterprises. Similarly, Eq. (3) is also established based on the benchmark model by adding the interaction items of household income $income_{it}$ and interaction between fintech and household income $DFI_{j,t-1} \times income_{it}$. Type (3) the test results will be used to analyze the financial innovation of science and technology how to influence people's income, the mechanism of conduction to the residents' consumption will analyze financial technology innovation and financial development of science and technology by creating a more efficient trading mechanism and transaction system, improve the trade efficiency and reduce transaction costs and provide convenient payment and consumer credit aspects to improve investment returns, the loosening of the budget constraint, Thus increasing income and expanding consumption influence mechanism.

The regression results of the entrepreneurial mechanism are shown in columns (1) and (2), and the regression results of the income transmission mechanism are shown in columns (3) and (4) in Table 7. The results show that after controlling for individual fixed effects, province fixed effects, and year fixed effects, the coefficients of $fintech_{j,t-1} \times entrepre_{i,t}$ and $fintech_{j,t-1} \times income_{i,t}$ are all significantly positive. These results confirm the existence of the entrepreneurial mechanism and income mechanism.

4.5. Heterogeneity test

Three aspects were tested in order to further analyze the structural impact of fintech on household consumption: regional heterogeneity, urban-rural heterogeneity, and wealth heterogeneity.

First of all, it is about the test of regional heterogeneity. The selected effective family samples are divided into eastern, central, and western regions according to their administrative regions. In addition, the differences in the impact of fintech development on household consumption in each region are tested and analyzed respectively. The test results are shown in Table 7. Among them, columns (1)–(3) use full sample data, and columns (4)–(6) use balanced panel data. The eastern region data are used in columns (1) and (4), the central region data are used in columns (2) and (5), and the western region data are used in columns (3) and (6). From the results, it can be seen that in columns (1) and (4), the fintech coefficient of the core explanatory variable is significantly greater than zero at the 1% level. Correspondingly, the fintech coefficient is not significant in other areas. The results show that compared with the underdeveloped areas in the central and western regions, the promoting effect of fintech on household consumption is more obvious in the eastern coastal areas. This is mainly because there is a big gap in the economic development between the east and the west of China, the west obviously lags behind the east, and the development of fintech in the east is also faster than that in the west. As a consequence, the role of fintech in promoting consumption is more obvious in the east. The test

results are in line with the reality of China.

Secondly, it is about urban and rural heterogeneity tests. In China, there are obvious differences in urban and rural economic development. This study is further divided into rural samples and urban samples according to the urban and rural categories to which the sample families belong, and tests and analyzes the urban and rural differences of the impact of fintech development on consumption in order to test whether there are household consumption differences between urban and rural areas. The results are shown in Table 8. Columns (1)–(2) in Table 8 use full sample data, and columns (3)–(4) use balanced panel data. Columns (1) and (3) use urban sample data, and columns (2) and (4) use rural sample data. The test results show that the coefficient of the core explanatory variable fintech is significantly positive in columns (1) and (3), but not significant in columns (2) and (4). This shows that fintech plays a more significant role in promoting urban household consumption, but not in rural household consumption. This may be due to the long-standing differences between urban and rural areas in China. As a result, it leads to the fact that the inclusive effect of fintech has not been fully shown in rural areas, and the breadth, depth, and digitization of fintech use by rural residents are low.

Finally, it is about the wealth heterogeneity test. According to the scale of household net worth, the sample families are divided into three types: wealthy families, medium families, and enterprising families. Specifically, the rich families are the top 20% of the net worth of the sample families, the middle families are the 50% of the net assets among the sample families, and the enterprising families are the families of the last 30% of the sample households. In the meanwhile, the influence of fintech on household consumption with different levels of wealth is tested and analyzed respectively. Table 9 shows the results of the wealth heterogeneity test. Columns (1)–(3) use full sample data and columns (4)–(6) use balanced panel data. Columns (1) and (4) are aimed at well-off families, columns (2) and (5) are for medium families, and columns (3) and (6) are for enterprising families. In columns (1) and (4), the core explanatory variable fintech coefficient is significantly greater than zero, but in the other four columns, the coefficient is not significant. The above results show once again that the promoting effect of fintech on consumption will show obvious heterogeneity with different levels of wealth. This is mainly due to the fact that wealthy families usually have a higher level of education and financial literacy, and are more likely to accept the services provided by fintech innovation, as well as a strong willingness and ability to consume. As a consequence, there is a significant positive correlation between the level of wealth and the level of consumption. However, the increase in the wealth of low-and middle-income residents will further stimulate consumption potential with the gradual deepening of fintech innovation in China.

It was further found that most of the eastern regions, urban residents, and wealthy residents overlap, and most of the western regions, rural residents, and low-and middle-income residents overlap according to the above heterogeneity test results. In other words, urban residents and wealthy residents are mainly concentrated in the eastern region, because the eastern region fintech is more developed, and the income level and quality of residents are relatively high and have higher income and consumption willingness, the role of promoting consumption is more obvious. While rural residents and low-and middle-income residents are mainly concentrated in the west because the level of fintech development in these areas is low, the income of residents is also relatively low, and the consumption capacity is insufficient, the role of fintech in promoting household consumption is not obvious. It can be seen that this promoting effect has a strong superposition effect. As a consequence, the promotion of fintech innovation to household consumption in China has only reached the effect of icing on the cake but has not yet achieved the original intention of providing charcoal in the snow at the present stage.

5. Conclusion and implications

Using the China family panel studies (CFPS) data and digital inclusive financial index (DFI), we explore the impact of fintech innovation on household consumption in this paper. We find that the development of fintech innovation can significantly improve the level of household consumption, which is basically consistent with the conclusion of Li et al. (2020). We also find that promoting entrepreneurship and increasing income are the two main transmission channels for fintech innovation to promote household consumption. Importantly, different from the existing studies (Li et al., 2020), we find that the effect of fintech innovation on household consumption has obvious heterogeneity. Compared with the economically underdeveloped areas in western China, fintech innovation plays a more obvious role in promoting the consumption of residents in the eastern areas. Compared with rural residents, fintech innovation plays a more significant role in promoting urban household consumption. In addition, the role of fintech in promoting consumption shows heterogeneity with the different levels of residents' wealth. The higher the level of wealth, the more significant the promoting effect of fintech innovation on their consumption. Thus, from the structural point of view, this promoting effect has a strong superposition effect. As a consequence, the effect of fintech innovation in China is limited, and the promotion of household consumption has only reached the effect of icing on the cake at the present stage. However, it has not yet achieved the original intention of providing charcoal in the snow manner.

The implications of this paper are as follows First, the policymakers, they should provide support policies for the development of financial technology, and promote the development of high-end core technologies such as big data and artificial intelligence. At the same time, it is necessary to strengthen the infrastructure construction, encourage the development of financial technology-related enterprises and the related supporting industries. The policymakers need to help families or individuals with entrepreneurial intentions to effectively use financial technology to obtain financial support, help them complete high-quality entrepreneurship, so as to increase their income and promote household consumption.

Second, the policymakers should focus on the fintech development policies for the western region, rural families, and low-and middle-income residents. The policies should further promote opportunities for all people to enjoy the achievements of financial technology development, and increase the use of Fintech innovation services for vulnerable groups such as farmers and low-income families. The policymakers need to pay attention to the credit needs and service quality of the vulnerable groups. At the same time, the policymakers should formulate relevant policies to improve the construction of fintech infrastructure services in western areas, improve the penetration and convenience of fintech innovation services, so as to effectively play the value of fintech innovation.

Author statement

We declare that we do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted.

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Appendix A. The merged table of heterogeneity tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Variable	Eastern (full sample)	Middle (full sample)	Western (full sample)	East (balance panel)	Middle (balance panel)	West (balance panel)	Urban (full sample)	Rural areas (full sample)	Urban (balance panel)	Rural areas (balance panel)	Affluence (full sample)	Medium (full sample)	Aggressive (full sample)	Affluence (balance panel)	Medium (balance panel)	Aggressive (balance panel)
fintech	0.347*** -2.99	0.226 -1.01	0.167 -0.53	0.468*** -2.86	0.226 -0.79	0.158 -0.37	0.245** -2.11	0.148 -1.08	0.297* -1.87	0.207 -1.17	0.282* -1.91	0.078 -0.55	0.13 -0.64	0.476** -2.5	0.126 -0.77	0.051 -0.2
cash	0.005*** -2.81	0 (-0.05)	0.004** -2.08	0.006*** -2.68	-0.001 (-0.22)	0.006** -2.24	0.005*** -2.81	0.002 -1.1	0.006*** -2.74	0.003 -1.32	0.007*** -2.81	0 (-0.30)	0.006*** -2.9	0.001 -0.39	-0.001 (-0.41)	0.011*** -4.1
size	0.132*** -16.22	0.134*** -17.18	0.123*** -14.46	0.126*** -11.3	0.128*** -12.26	0.127*** -11.31	0.148*** -18.61	0.121*** -19.52	0.138*** -12.22	0.121*** -14.83	0.131*** -13.42	0.122*** -17.25	0.139*** -16.64	0.135*** -11.11	0.118*** -14.37	0.136*** -12.92
age	-0.015*** (-13.22)	-0.013*** (-9.54)	-0.015*** (-11.67)	-0.017*** (-11.26)	-0.013*** (-6.82)	-0.014*** (-8.02)	-0.012*** (-10.25)	-0.014*** (-14.19)	-0.011*** (-7.07)	-0.014*** (-10.61)	-0.012*** (-8.16)	-0.013*** (-12.56)	-0.019*** (-14.27)	-0.014*** (-7.03)	-0.014*** (-11.25)	-0.018*** (-10.97)
gender	0.041** -2.26	0.045** -2.02	0.060** -2.53	0.057** -2.42	0.060** -2.07	0.041 -1.37	0.041** -2.32	0.050*** -2.91	0.042* -1.77	0.051** -2.38	0.047* -1.94	0.031* -1.91	0.067*** -2.7	0.048 -1.55	0.035* -1.82	0.057* -1.86
marriage	-0.024 (-1.37)	-0.068*** (-3.34)	-0.021 (-1.13)	-0.011 (-0.47)	-0.089*** (-2.86)	0.013 -0.52	-0.030* (-1.81)	-0.045*** (-3.03)	-0.041* (-1.72)	-0.027 (-1.26)	-0.011 (-0.50)	-0.028* (-1.71)	-0.049*** (-2.60)	-0.021 (-0.71)	-0.013 (-0.61)	-0.028 (-1.13)
education	0.049*** -4.11	0.043*** -3.1	0.040*** -2.89	0.045*** -2.88	0.048*** -2.58	0.042** -2.37	0.034*** -2.97	0.033*** -2.94	0.016 -1.04	0.044*** -3.06	0.050*** -3.21	0.049*** -4.66	0.033** -2.21	0.040** -1.99	0.049*** -3.89	0.036** -1.99
hukou	0.063*** -3.39	0.015 -0.61	0.03 -1.27	0.078*** -3.14	0.018 -0.56	0.044 -1.53	0.042** -2.52	0.021 -1.06	0.052** -2.24	0.044* -1.78	0.057** -2.29	0.023 -1.3	0.072*** -2.96	0.054* -1.76	0.041* -1.94	0.077** -2.53
health	0.022*** -3.17	0.009 -1.08	0.012 -1.47	0.015 -1.64	0.011 -1.03	0.016 -1.54	0.008 -1.16	0.016*** -2.78	0.007 -0.7	0.018** -2.46	0.011 -1.13	0.013** -1.99	0.019** -2.35	0.006 -0.51	0.012 -1.64	0.025*** -2.51
employ	-0.001 (-0.23)	0.012* -1.73	-0.018** (-2.26)	0.002 -0.18	0.002 -0.23	-0.018* (-1.65)	-0.01 (-1.58)	-0.002 (-0.44)	-0.007 (-0.81)	-0.007 (-0.91)	-0.001 (-1.11)	-0.008 (-1.40)	-0.001 (-0.17)	-0.009 (-0.79)	-0.008 (-1.02)	-0.006 (-0.67)
Constant	10.467*** -38.04	9.616*** -57.59	9.491*** -18.51	10.369*** -36.84	10.176*** -54.57	10.072*** -52.39	10.382*** -52.76	9.828*** -32.87	10.413*** -40.7	9.860*** -28.57	10.359*** -38.41	10.498*** -50.51	10.252*** -39.89	10.600*** -33.36	10.441*** -42.38	10.226*** -33.25
Number of samples	14,508	10,318	10,272	6711	5104	5461	15,972	19,126	6879	10,397	7134	15,929	9727	3843	10,561	5918
R-squared	0.178	0.179	0.14	0.182	0.169	0.128	0.206	0.12	0.196	0.116	0.235	0.171	0.164	0.234	0.168	0.161
Number of individuals	5768	3826	3606	1794	1324	1396	7065	7099	2120	2916	2671	5255	3314	1031	2791	1559
Individual fixation effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Provincial fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

References

- Agarwal, S., Liu, C., & Souleles, N. S. (2007). The reaction of consumer spending and debt to tax rebates—Evidence from consumer credit data. *Journal of Political Economy*, 115(6), 986–1019.
- Aghion, P., & Bolton, P. (1997). A theory of trickle-down growth and development. *The Review of Economic Studies*, 64(2), 151–172.
- Aguilar, M., & Bils, M. (2015). Has consumption inequality mirrored income inequality? *American Economic Review*, 105(9), 2725–2756.
- Ahluwalia, S., Mahto, R. V., & Guerrero, M. (2020). Blockchain technology and startup financing: A transaction cost economics perspective. *Technological Forecasting and Social Change*, 151, 119854.
- Al-Nawayseh, M. K. (2020). Fintech in COVID-19 and beyond: What factors are affecting customers' choice of FinTech applications? *Journal of Open Innovation: Technology, Market, and Complexity*, 6(4), 1–15.
- Amer, D. W., Buckley, R. P., Zetzsche, D. A., et al. (2020). Sustainability, FinTech and financial inclusion. *Social Science Electronic Publishing. European Business Organization Law Review*, 21(1), 7–35.
- Anand, S. K., & Chhikara, K. S. (2013). A theoretical and quantitative analysis of financial inclusion and economic growth. *Management and Labor Studies*, 38(1–2), 103–133.
- Bachmann, R., & Sims, E. R. (2012). Confidence and the transmission of government spending shocks. *Journal of Monetary Economics*, 59(3), 235–249.
- Baker, S. R., & Yannelis, C. (2017). Income changes and consumption: Evidence from the 2013 federal government shutdown. *Review of Economic Dynamics*, 23, 99.
- Beck, T., Pamuk, H., Ramrattan, R., & Uras, B. R. (2018). Payment instruments, finance and development. *Journal of Development Economics*, 133, 162–186.
- Begenau, J., Farboodi, M., & Veldkamp, L. (2018). Big data in finance and the growth of large firms. *Journal of Monetary Economics*, 97, 71–87.
- Berger, A. N. (2003). The economic effects of technological progress: Evidence from the banking industry. *Journal of Money, Credit and Banking*, 141–176.
- Blundel, R., Pistaferri, L., & Preston, I. (2008). Consumption inequality and partial insurance. *American Economic Review*, 98(5), 1887–1921.
- Blundell, R., Pistaferri, L., & Saporta-Eksten, I. (2018). Children, time allocation, and consumption insurance. *Journal of Political Economy*, 126(S1), S73–S115.
- Blundell, R., & Preston, I. (1998). Consumption inequality and income uncertainty. *The Quarterly Journal of Economics*, 113(2), 603–640.
- Bonaparte, Y., Cooper, R., & Zhu, G. (2012). Consumption smoothing and portfolio rebalancing: The effects of adjustment costs. *Journal of Monetary Economics*, 59(8), 751–768.
- Broby, D., Hoepner, A., Klausmann, J., et al. (2018). The output and productivity benefits of fintech collaboration: Scotland and Ireland. *SIFI Fintech*, 1–13.
- Buchak, G., Matvos, G., Piskorski, T., & Seru, A. (2018). Fintech, regulatory arbitrage, and the rise of shadow banks. *Journal of Financial Economics*, 130(3), 453–483.
- Bunea, S., Kogan, B., & Stolin, D. (2016). Banks vs fintech: At last, it's official. *Journal of Financial Transformation*, 44, 122–131.
- Cortina Lorente, J. J., & Schmukler, S. L. (2018). The fintech revolution: a threat to global banking? *World Bank Research and Policy Briefs*, 4(14), 125038.
- Demertzis, M., Merler, S., & Wolff, G. B. (2018). Capital markets union and the fintech opportunity. *Journal of Financial Regulation*, 4(1), 157–165.
- Farboodi, M., & Veldkamp, L. (2020). Long-run growth of financial data technology. *American Economic Review*, 110(8), 2485–2523.
- FSB, F. (2016). *Describing the landscape and a framework for analysis, research report, March*.
- Goldfarb, A., & Tucker, C. (2019). Digital economics. *Journal of Economic Literature*, 57(1), 3–43.
- Grossman, J., & Tarazi, M. (2014). *Serving smallholder farmers: Recent developments in digital finance. CGAP focus note*. No. 94. Washington, DC: World Bank Group, 2014.
- Haddad, C., & Hornuf, L. (2019). The emergence of the global Fintech market: Economic and technological determinants. *Small Business Economics*, 53(1), 81–105.
- Heiskanen, A. (2017). The technology of trust: How the Internet of Things and blockchain could usher in a new era of construction productivity. *Construction Research and Innovation*, 8(2), 66–70.
- Jack, W., & Suri, T. (2014). Risk sharing and transactions costs: Evidence from Kenya's mobile money revolution. *American Economic Review*, 104(1), 183–223.
- Jones, C. I., & Tonetti, C. (2020). Nonrivalry and the economics of data. *American Economic Review*, 110(9), 2819–2858.
- Kaplan, G., & Violante, G. L. (2014). A model of the consumption response to fiscal stimulus payments. *Econometrica*, 82(4), 1199–1239.
- Koffi, H. W. S. (2016). The Fintech revolution: An opportunity for the West African financial sector. *Open Journal of Applied Sciences*, 6(11), 771–782.
- Krueger, D., & Perri, F. (2006). Does income inequality lead to consumption inequality? Evidence and theory. *The Review of Economic Studies*, 73(1), 163–193.
- Lai, J. T., Yan, I. K. M., Yi, X. J., & Zhang, H. (2020). Digital financial inclusion and consumption smoothing in China. *China & World Economy*, 28(1), 64–93.
- Le, L. T. N., Yarovaya, L., & Nasir, M. A. (2021). Did COVID-19 change spillover patterns between Fintech and other asset classes? *Research in International Business and Finance*, 101441.
- Le, M. T. (2021). Examining factors that boost intention and loyalty to use Fintech post-COVID-19 lockdown as a new normal behavior. *Heliyon*, 7(8), Article e07821.
- Li, J., Wu, Y., & Xiao, J. (2020). The impact of digital finance on household consumption: Evidence from China. *Economic Modelling*, 86, 317–326.
- Lise, J., & Seitz, S. (2011). Consumption inequality and intra-household allocations. *The Review of Economic Studies*, 78(1), 328–355.
- Liu, T., Pan, B., & Yin, Z. (2020). Pandemic, mobile payment, and household consumption: micro-evidence from China. *Emerging Markets Finance and Trade*, 56(10), 2378–2389.
- Ludvigson, S. (1999). Consumption and credit: A model of time-varying liquidity constraints. *Review of Economics and Statistics*, 81(3), 434–447.
- Meyer, B. D., & Sullivan, J. X. (2013). Consumption and income inequality and the great recession. *American Economic Review*, 103(3), 178–183.
- Moeninghoff, S. C., & Wieandt, A. (2013). The future of peer-to-peer finance. *Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung*, 65(5), 466–487.
- Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. *Borsa Istanbul Review*, 18(4), 329–340.
- Riley, E. (2018). Mobile money and risk sharing against village shocks. *Journal of Development Economics*, 135, 43–58.
- Sarma, M., & Pais, J. (2011). Financial inclusion and development. *Journal of International Development*, 23(5), 613–628.
- Xu, J., Gao, M., & Zhang, Y. (2021). The variations in individual consumption change and the substitution effect under the shock of covid-19: evidence from payment system data in China. *Growth and Change*, 2, 12477.
- Yang, B., & Ching, A. T. (2014). Dynamics of consumer adoption of financial innovation: The case of ATM cards. *Management Science*, 60(4), 903–922.
- Zandi, M., Singh, V., & Irving, J. (2016). The impact of electronic payments on economic growth. *Moody's Analytics: Economic and Consumer Credit Analytics*, 2, 2016.
- Zavolokina, L., Dolata, M., & Schwabe, G. (2016). The FinTech phenomenon: Antecedents of financial innovation perceived by the popular press. *Financial Innovation*, 2, 1–16.
- Zimmerman, F. J., & Carter, M. R. (2003). Asset smoothing, consumption smoothing and the reproduction of inequality under risk and subsistence constraints. *Journal of Development Economics*, 71(2), 233–260. **TnQ**