

Article

Research on the Impact of Digital Inclusive Finance on the Financial Vulnerability of Aging Families

Xingqi Wang ^{1,*} and Zhenhua Mao ^{1,2}

¹ Dong Fureng Institute of Economic and Social Development, Wuhan University, Wuhan 430072, China; zhmao@hku.hk

² Faculty of Business and Economics, The University of Hong Kong, Hong Kong 999077, China

* Correspondence: wangxingqi@whu.edu.cn

Abstract: In recent years, the issue of population aging has been a challenge for China's economic and social development. Due to factors such as the imperfect pension security system, the financial vulnerability of families has been greatly impacted by population aging. Digital inclusive finance is a financial model that utilizes digital technology and innovative approaches to provide financial services to low-income groups and impoverished areas. With the rapid development of the concept of digital inclusive finance, an increasing number of households are beginning to use digital inclusive finance products. It is worth exploring whether this financial model can help alleviate the financial vulnerability of aging families. Therefore, it is of both theoretical and practical significance to study the role of digital inclusive finance in improving the financial vulnerability of aging families. This study assembled unbalanced panel data using both 2016 and 2018 China Household Tracking Survey (CFPS) data and the digital financial inclusion index. An empirical analysis was conducted using the ordered probit panel model. The research findings indicate the following: First, the increasing elderly population intensifies the financial vulnerability of families. Second, digital inclusive finance plays a significant role in improving the financial stability of aging families. Third, digital inclusive finance helps alleviate the impact of population aging on family financial vulnerability by mitigating credit constraints and increasing household income. Fourth, a heterogeneity analysis suggests that in female-headed households, the financial vulnerability caused by population aging is more severe, and the role of digital inclusive finance in improving family financial vulnerability is more prominent. Additionally, the purchase of commercial insurance can effectively alleviate the financial vulnerability of families caused by population aging.



Citation: Wang, Xingqi, and Zhenhua Mao. 2023. Research on the Impact of Digital Inclusive Finance on the Financial Vulnerability of Aging Families. *Risks* 11: 209. <https://doi.org/10.3390/risks11120209>

Academic Editor: Mogens Steffensen

Received: 24 September 2023

Revised: 12 November 2023

Accepted: 14 November 2023

Published: 29 November 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Keywords: aging; digital inclusive finance; family financial fragility

1. Introduction

The current global trend of population aging has led to widespread concerns over a series of social issues. The issue of aging is faced not only by developed countries but also by many developing countries that are beginning to grapple with this challenge. Studies have shown that many developing countries are confronting the impacts of aging on household financial vulnerability. For instance, Brazil, while advancing its economy, is dealing with increased life expectancy and decreased fertility rates, intensifying the vulnerability of household finances. Additionally, countries like India, Thailand, and Mexico are also facing the aging dilemma, with the ensuing high medical and retirement expenses challenging the resilience of household finances. As a populous country, China also faces severe challenges resulting from population aging. According to international standards, China became an aging society in the year 2000, and the number of elderly people has been steadily increasing. As of the end of 2022, the proportion of people aged 65 and above in China reached 14.9%, surpassing the world average of 9.3%. From a family perspective, the emergence of aging brings forth various issues for families, such

as inadequate social security, reduced income, and increased uncertainty in expenditures. Currently, the main financial risks faced by aging families in China include (1) liquidity constraints due to insufficient retirement savings resulting from increased life expectancy (Ba et al. 2023); (2) increased health risks for families, even leading to debt problems (Zhang et al. 2022; Ruan and Huan 2020); (3) a decrease in labor supply from aging individuals and other members of the family, resulting in reduced family income (Gao et al. 2006; Zhou and Liu 2016); (4) higher levels of risk aversion in families with a higher proportion of elderly members, leading to a decrease in property income. It is evident that population aging undoubtedly contributes to financial fragility in families. Therefore, it is crucial to address the negative impact of aging on family finances and safeguard the financial stability of aging families. This article, using China as a case study, aims to provide insights for developing countries in addressing the impacts of aging on household financial vulnerability. In recent years, digital inclusive finance has experienced rapid development in China. According to the “Peking University Digital Inclusive Finance Index (2011–2020)” report, the median value of the digital inclusive finance index across the provinces in China increased from 33.6 in 2011 to 334.8 in 2020, nearly a nine-fold increase¹. Digital inclusive finance, with its advantages of broad coverage, low cost, and fast speed, can benefit a wider range of people and significantly reduce transaction barriers and costs for both parties involved. It provides possibilities for alleviating liquidity constraints and promoting income growth for families, thus helping to mitigate family financial fragility. To date, there have been in-depth studies in academia on population aging, digital inclusive finance, and their impact on family financial fragility. However, research that combines these three aspects is still limited. Therefore, this study takes an aging perspective and utilizes panel data from the 2016 and 2018 China Family Panel Studies (CFPS) to investigate the impact of digital inclusive finance on the financial fragility of aging families and its mitigating effect. This research not only contributes to a deeper understanding of the financial risks faced by aging families in China but also provides practical evidence for mitigating their financial fragility, improving their well-being, and avoiding financial distress. It can also serve as a reference for government policymakers in formulating relevant policies. This study holds significant practical and theoretical significance for alleviating the financial fragility of aging families, safeguarding their financial stability, and enhancing their welfare.

The research objective of this paper is to explore the impact of aging on family financial fragility and the moderating role of digital inclusive finance. The specific objectives are as follows: First, theoretically analyze the impact of population aging on family financial fragility and the moderating role of digital inclusive finance are theoretically analyzed. Second, the impact of aging on family financial fragility and the moderating role of digital inclusive finance are empirically studied. Third, mediating variables are introduced to further examine the mechanisms through which digital inclusive finance affects the financial fragility of aging families. Fourth, the impact of digital inclusive finance on the financial fragility of aging families is explored through robustness tests and heterogeneity analysis. Fifth, the research findings from the previous sections are summarized, and specific policy recommendations are provided.

2. Literature Review

2.1. Research on Digital Inclusive Finance

Digital inclusive finance is a concept officially introduced during the “2005 International Year of Microcredit”. Its aim is to increase investment in financial infrastructure, making the financial service system more comprehensive and widely accessible. Zhou (2013) stated that financial inclusion involves intensifying efforts to build financial infrastructure, allowing all segments of society in need of financial support (especially those with low income and in economically underdeveloped areas) to access high-quality financial services at fair and reasonable prices. Compared to traditional financial inclusion, digital inclusive finance has broader coverage and is beneficial in addressing the mismatch of

financial resources, thereby bringing new opportunities for the development of the real economy (Zhong et al. 2022).

Research on the impact of digital inclusive finance currently focuses on two main levels. The first level is the macro level. Digital inclusive finance not only promotes economic growth but also helps alleviate economic poverty (Teng and Ma 2020; Kapoor 2014). Research by Qian et al. (2020) found that low-income groups benefit more from the development of digital inclusive finance compared to high-income groups. However, the fundamental positive effect of digital inclusive finance on narrowing the income disparity between urban and rural residents has not been fully realized (Zhou 2022). Furthermore, digital inclusive finance can enhance social security levels and regional innovation capabilities (Wang et al. 2020; Xu et al. 2020). Some scholars have also observed a significant increase in the development of digital inclusive finance in rural areas, with a general trend toward decreasing relative differences nationwide (Zhang and Xing 2021). The second level is the micro level. Allen et al. (2016) found that digital inclusive finance contributes to expanding residents' employment levels, thereby increasing their wage income. Meanwhile, Feng et al. (2020) discovered a positive effect of digital inclusive finance on stimulating residents' entrepreneurial enthusiasm, and similar conclusions have been drawn by other researchers (Xie et al. 2018; Huang and Zeng 2021; Li 2021). Additionally, Bayoumi (1993) found that resident consumption continues to grow with the expansion of financial services (Bayoumi 1993), and Campbellely and Mankiw (1993) argued that digital inclusive finance alleviates financial exclusion, expanding the population with access to financial services and releasing more consumption demand. Zhang et al. (2020a) reached the conclusion through theoretical analysis and empirical research that digital finance promotes resident consumption by enhancing payment convenience. Zhang et al. (2022) and Zhang and Zheng (2013) also found that compared to traditional financial inclusion, digital inclusive finance is more effective in improving families' financial asset allocation (Zhang and Zheng 2013).

2.2. Research on the Correlation between Family Financial Fragility and Aging

2.2.1. Family Financial Fragility

Family financial fragility gained scholarly attention starting in the 1960s. Initially, fragility was primarily used in the field of engineering. Later, Minsky introduced fragility into the financial field and proposed the "financial fragility hypothesis" in 1982, which refers to narrow-sense financial fragility. From a broader perspective, Huang (2001) suggested that financial fragility represents a financially risky condition. Marchettini and Leika (2017) argued that family financial fragility can be used as an indicator to assess the likelihood of families facing financial distress (Marchettini and Leika 2017).

Scholars have conducted extensive research on the factors influencing family financial fragility, and a review of the relevant literature, both domestic and international, reveals that family financial fragility is influenced by individual characteristics, family characteristics, and socioeconomic factors.

At the individual characteristic level, the family head's decision making regarding family plans is influenced by their own characteristics, which, in turn, affect the family's financial fragility. Lusardi (2011) observed that families with male heads tend to have lower financial fragility, a finding echoed by Brunetti et al. (2016), who also noted more severe financial fragility in divorced, single, or widowed families (Brunetti et al. 2016; Vandone et al. 2016; Kim et al. 2014). Additionally, research has shown that families engaged in temporary employment, compared to those in stable jobs, experience greater financial instability and are more likely to face financial difficulties (Albacete and Lindner 2013). Yusof (2018) identified a significant negative relationship between the educational attainment of the family head and the family's financial fragility, suggesting that higher education correlates with reduced fragility. Furthermore, Ampudia et al. (2014) revealed that families with younger heads have higher financial fragility compared to those with older heads.

At the family characteristic level, the greater the wealth possessed by families, the lower the likelihood of financial distress and the lower the financial fragility (Zhou and Chen 2022; Yusof et al. 2015; Zhang et al. 2020b). Additionally, La Cava and Simon (2005) found that families with homeownership exhibit relatively lower financial fragility when facing risk shocks (La Cava and Simon 2005). However, some scholars argue that families with higher debt-to-income ratios, which are typically found in homeownership families, experience higher financial fragility when facing risk shocks (Xie 2018). It has also been found that rural families have higher financial fragility compared to urban families. Lusardi (2011) suggest that as the dependency ratio of children and elderly individuals within families increases, families are more likely to accumulate rigid educational and medical debts, thus increasing the possibility of financial distress and raising their financial fragility.

At the socioeconomic level, higher income inequality increases the financial fragility of families (Jappelli et al. 2013). Furthermore, Abid and Shafia (2018) empirically found that factors contributing to higher family financial fragility include debt, inflation, interest rates, and unemployment rates, while income serves as a mitigating factor for reducing family financial fragility. Xie (2018) discovered that the New Rural Social Pension Scheme helps alleviate the financial fragility of low-income families during the receipt stage but worsens their financial fragility during the contribution stage.

2.2.2. The Relationship between an Aging Population and Family Financial Fragility

According to international standards, population aging refers to the dynamic increase in the proportion of the elderly population within the total population. The main criterion for determining whether a country or region is experiencing population aging is whether the proportion of the population aged 60 and above or 65 and above reaches 10% and 7% of the total population, respectively. If these respective values are reached, it indicates that the country or region has become an aging society. In this study, aging families are defined as families with at least one person aged 65 and above.

Yi and Wang (2012) utilized a predictive model of elderly care cost to find that population aging leads to an increase in the cost of elderly care. Christelis et al. (2009) analyzed the financial fragility of the elderly population in Europe and conducted a heterogeneity analysis from perspectives such as nationality, age, and health conditions. Zhang et al. (2022) discovered a significant upward trend in financial fragility among middle-aged and elderly families, and health shocks further increased the financial fragility, particularly in middle-income and rural families. Zhao et al. (2021b) conducted empirical research using micro-level data from Chinese families and found that physical functioning declines with age, which hampers the stability of family income and increases financial fragility. Wen (2020) found that financial asset investments can reduce the financial fragility of families. Fu et al. (2020) empirically studied the impact of health shocks on asset allocation decisions in elderly families and found that elderly families tend to prefer more conservative asset allocation strategies after experiencing health shocks.

2.3. Research on the Correlation between Digital Inclusive Finance and the Financial Fragility of Aging Families

Fan and Dai (2022) found through theoretical reasoning and empirical research that aging increases the financial risks faced by families, thus raising the financial fragility of aging families. Further research revealed that digital inclusive finance can mitigate the negative impact of aging on family finances. Chen and Wang (2022) discovered that digital inclusive finance can alleviate the positive influence of multidimensional relative poverty among the elderly, while the digital divide exacerbates multidimensional relative poverty among the elderly and weakens the positive effect of digital inclusive finance. Zhang and Han (2021) found that the alleviating effect of digital finance on poverty fragility diminishes as the proportion of elderly individuals in families increases.

In summary, previous research at the micro level of family finances has primarily focused on the impact of digital inclusive finance on family income, consumption, bor-

rowing, and asset allocation. It has mainly revolved around two aspects: the increased financial risks faced by families due to population aging and the reduced ability of families to cope with risk shocks due to population aging. However, research on the impact of digital inclusive finance on the financial aspects of aging families remains relatively scarce.

3. Theoretical Analysis and Research Assumptions

3.1. Theoretical Foundations

The theoretical foundations of this study include the life-cycle hypothesis, precautionary saving theory, financial exclusion theory, and financial inclusion theory. These theories provide the following basis for this study: (1) The life-cycle hypothesis explains that when the elderly dependency ratio changes in a family, the family's savings and consumption also change accordingly, providing a basis for the existence of financial fragility in aging families. (2) The precautionary saving theory suggests that consumers' savings are positively correlated with the future risks they face. As the elderly population increases in a family, it faces greater economic pressure, leading to an inclination toward increased savings and providing a basis for the existence of financial fragility in aging families. (3) The financial exclusion theory indicates that financial services do not cater to the entire population and certain groups are excluded, thus providing a basis for the existence of financial fragility in aging families. (4) The financial inclusion theory highlights that financial inclusion aims to enable a larger population to access financial products and services offered by financial institutions at reasonable costs, not limited to specific regions or groups. Lower financial costs and broader service coverage contribute to better and faster economic growth. The development of digital inclusive finance promotes the inclusiveness of financial products and services, providing a basis for addressing the financial fragility of aging families.

3.2. Research Hypotheses

In China, family-based care is the predominant form of elderly care. On the one hand, entering old age implies a decline in labor capacity, which hinders income generation. At the same time, the reduced caregiving provided by other family members to the elderly diminishes their own labor supply, leading to a decrease in family income and a weakened ability to withstand uncertainty shocks. On the other hand, due to the low penetration rate of commercial insurance and the incomplete coverage of social medical insurance in China, family expenditures on medical costs become rigid, squeezing out investments in less rigid factors of production and education. The former results in a decline in family production efficiency, while the latter leads to a reduction in human capital within the family (Jian and Xu 2019). Furthermore, emotional issues resulting from health shocks may affect residents' decision making, thus influencing family financial decisions and negatively impacting family finances (Chen et al. 2008; Hu 2016). Therefore, while diminishing families' ability to cope with risks, aging increases the financial risks faced by families, thus raising the probability of financial fragility. Based on this, this study proposes the following hypothesis:

H₁: *Aging increases the degree of financial fragility in families.*

The development of digital inclusive finance has broken the constraints of time and space, reducing the costs for households, particularly vulnerable groups, to access financial services (Allen et al. 2021). Allen also found that the effectiveness of digital inclusive finance is particularly pronounced among vulnerable groups. Moreover, it enables financial institutions to obtain relevant customer information, alleviating the issue of a reluctance to lend due to information asymmetry. Additionally, the involvement of emerging Internet finance companies, such as JD Finance and Ant Group, has addressed some of the financial service needs of families. Yin and Zhang (2020) found that inclusive finance not only promotes entrepreneurial behavior in families but also enhances their risk management capacity, thereby reducing the probability of financial distress (Yin and Zhang 2020). Therefore, digital inclusive finance improves the ability of families to withstand risks by

directly reducing time costs and transaction costs. Based on this, the following hypothesis is proposed in this study:

H₂: *Digital inclusive finance can mitigate the impact of population aging on family financial fragility.*

Zhao et al. (2021a) found that formal financial borrowing helps reduce poverty fragility in rural families, while informal financial borrowing increases poverty fragility in rural families. Digital inclusive finance helps to alleviate the friction in the local credit supply in the credit market and extends the “frontier” of credit availability to vulnerable groups with lower credit scores (Allen et al. 2021). Digital inclusive finance effectively improves financial accessibility for households, alleviates credit constraints for some low-income residents, and reduces their reliance on borrowing from informal financial institutions, which is beneficial in lowering the financial fragility of households (Qi and Zhang 2019). Based on this, the following hypothesis is proposed in this study:

H₃: *By reducing credit constraints, digital inclusive finance mitigates the impact of population aging on family financial fragility.*

Previous studies have found a significant relationship between family financial fragility and family income. On the one hand, Lusardi (2011) found that lower cash inflows make it difficult for low-income families to cope with unexpected situations. On the other hand, heavily indebted families with high debt-to-income ratios may face financial difficulties due to their inability to repay debts in a timely manner. Digital inclusive finance, with its low cost and convenience, enables more small and medium-sized enterprises to access the funds needed for expanding production at an appropriate cost, thereby promoting inclusive economic growth (Banerjee and Duflo 2014). Digital inclusive finance provides greater financial support to small and medium-sized enterprises (SMEs) with lower credit scores, promoting their better development (Allen et al. 2021). The expansion of production by small and medium-sized enterprises creates more job opportunities and increases family income. Additionally, inclusive economic growth contributes to increased government fiscal revenue, leading to increased transfer payments to low-income individuals. Therefore, the development of digital inclusive finance contributes to higher family income and reduces financial fragility. Based on this, the following hypothesis is proposed in this study:

H₄: *By increasing family income, digital inclusive finance mitigates the impact of population aging on family financial fragility.*

4. Descriptive Statistical Analysis

4.1. Data Source and Data Processing

The China Family Panel Studies (CFPS) aims to collect data at the individual, family, and community levels. This project is a nationwide and comprehensive social tracking survey conducted by the Institute of Social Science Survey (ISSS) at Peking University. The variables involved in this study mainly include three levels: individual, family, and regional. The data on resident families and individuals primarily come from the datasets for 2016 and 2018, which include basic variables such as family income, expenditure, and debt, as well as family-head characteristics and other related variables. The selection of this database for this study is based on the following four reasons: First, the project team updated the original test version data for 2018 at the end of 2020 and added several variables. Although the 2020 version of the data has been gradually made available, many survey questionnaires were conducted via telephone interviews due to the pandemic, resulting in a higher level of missing data in those questionnaires. Second, this database collects and reflects relevant information about families, and the 2016 and 2018 datasets have comprehensive information that aligns well with the research theme of this study. Third, due to changes in the project team’s survey objectives in 2020, many questionnaire items were modified; thus, the 2016 and 2018 versions of the database were still chosen for this study. Fourth, the CFPS data sample is a multi-stage probability sample extracted

using an implicit stratification method, with each sub-sample obtained through three stages of extraction. This survey sample has a large size, wide coverage, and low refusal rate, and the data are highly representative and of good quality, providing solid data support for this study. Since its release, a large number of scholars have used the data from this database to explore family behavior, and the research results have been published in major mainstream journals, gaining unanimous recognition from the academic and professional communities (He 2022). The data collection methods for this dataset include multi-level, multi-stage probability sampling; face-to-face interviews; longitudinal tracking; and a wide coverage area, which can avoid survivorship bias.

The Peking University Digital Financial Inclusion Index of China (PKU_DFIIC) consists of three primary indicators: breadth of coverage, depth of usage, and degree of digitization. The project team has published three editions of the digital inclusive financial index, covering the period from 2011 to 2020. The index has the following four characteristics: (1) Comprehensive Index Design: The PKU_DFIIC is a comprehensive index that includes multiple aspects, such as coverage breadth, usage depth, and digitization level. This multidimensional measurement method is intended to fully reflect the state of digital inclusive finance, rather than merely focusing on specific “surviving” or successful cases. (2) Wide Range of Data Sources: The data for this index come from public data, as well as statistics from government and financial institutions. This usually encompasses a variety of financial institutions and services, not just specific, existing entities. (3) Aimed at Trend Analysis and Policy Guidance: The PKU_DFIIC is designed for analyzing trends and guiding policy, necessitating that it provides as comprehensive and accurate a market overview as possible, rather than focusing solely on specific successful or existing cases. (4) Regular Updates and Comprehensive Coverage: The index is regularly updated and covers all provincial administrative regions of China, meaning it aims to capture a broad, cross-temporal range of data, rather than just focusing on specific points in time or specific cases. Therefore, the index can comprehensively depict the overall development level and future trends of digital inclusive finance in China without causing survivorship bias. The specific indicators and dimensions of the index are presented in Table 1. In this study, the digital inclusive financial indicators and their sub-indicators for each district and county were adopted from the Peking University Digital Inclusive Financial Index.

Table 1. System of indicators for digital inclusive finance.

Primary Indicators	Weight	Secondary Indicators	Indicator Content
Coverage breadth	54%	Account Coverage Rate	Number of Alipay accounts per 10,000 people, proportion of Alipay users with linked bank cards, average number of bank cards linked to Alipay accounts
Usage depth	29.70%	Payment services, insurance services, money market fund services, credit services, investment services, and credit services	Including Alipay payments, consumer credit, business loans, insurance, Internet investment, and credit reporting services
Degree of digitization	16.30%	Mobilization, affordability, creditization, convenience	Mobile payment usage, affordability of loans, Alipay Huabei usage, QR code usage

Data source: The Peking University Digital Inclusive Financial Index of China.

In this study, the macro-level variables at the regional level mainly come from the National Bureau of Statistics.

The data years used in this paper are 2016 and 2018, that is, unbalanced panel data. To ensure the validity of the empirical analysis, the following procedures were conducted on the CFPS data from 2016 and 2018 in this study:

1. Excluding samples with responses of “don’t know” in the questionnaire survey.
2. Excluding samples with contradictory responses in the questionnaire.

3. Excluding samples with illogical data, such as negative debt amounts for sample families.
 4. Applying 5% winsorization to the sample data.
 5. Horizontally merging individual-level and family-level data for the same year and then vertically merging the data from 2016 and 2018.
 6. Due to privacy concerns, the publicly available database only provides provincial-level information on the samples and does not include information on cities at or above the prefecture level. Therefore, to match the data, the digital inclusive financial index at the provincial level from 2015 and 2017 was selected for analysis in this study.
- After implementing the above procedures, the final sample size was 11,967.

4.2. Variable Selection

4.2.1. Dependent Variable

The dependent variable chosen in this study is family financial fragility, which is measured from a debt perspective following the studies of [Meng et al. \(2019\)](#).

Following the study by [Michelangeli and Pietrunti \(2014\)](#), this study defines families with a debt-to-income ratio exceeding 30% as overindebted families and assigns them a value of 1. Conversely, families with a debt-to-income ratio below 30% are defined as non-overindebted families and assigned a value of 0. Emergency savings refer to the savings that enable families to maintain their current living standards in the face of income and expenditure shocks. Considering that unemployment significantly impacts income and that individuals generally require 3–6 months to secure reemployment ([Chang et al. 1993](#)), following the approach of [Brunetti et al. \(2016\)](#), this study defines families with emergency savings of less than three months' worth of daily living expenses as inadequately prepared for emergencies and assigns them a value of 1 while assigning a value of 0 to adequately prepared families.

In summary, this study categorizes family financial fragility into three levels: low, medium, and high. The corresponding values for family financial fragility are 0, 1, and 2, respectively. Specifically, if a family is not overindebted and has sufficient emergency savings, its financial fragility indicator is assigned a value of 0, indicating low financial fragility. If a family is overindebted but has sufficient emergency savings, or if a family is not overindebted but lacks sufficient emergency savings, its financial fragility indicator is assigned a value of 1, indicating medium financial fragility. If a family is both overindebted and lacks sufficient emergency savings, its financial fragility indicator is assigned a value of 2, indicating high financial fragility.

4.2.2. Explanatory Variables

- Aging Index

In this study, aging families are defined as those with at least one individual aged 65 or above. The proportion of individuals aged 65 or above in the total family population is selected as a proxy variable for aging based on the CFPS survey data.

- The Digital Inclusive Financial Index

The digital inclusive financial index is used in this study to describe the development of digital inclusive financial in the districts or counties where the families are located.

- Control Variables

Taking into account the characteristics of the family head's human capital and life-cycle stage, as well as factors at the family and regional levels that may influence the estimation results, the following variables were selected as control variables, following previous research by [Yue et al. \(2021\)](#): family-head-level variables (age, gender, education level, health condition, family registration type, marital status), family-level variables (family size, proportion of young children, ownership of commercial insurance, vehicle

purchasing cost, individual business ownership, ownership of residential property), and regional-level variables (GDP level), as shown in Table 2 (Yue et al. 2021; Li and Zhu 2020).

Table 2. Description of variable usage.

	Variable Name	Variable Meaning	Variable Description	Measurement Method
Dependent variable	FV	Financial fragility of family	The higher the value, the greater the degree of financial fragility of the family	0 represents low fragility 1 represents moderate fragility 2 represents high fragility
Independent variables	elder_rate	Aging population	Percentage of elderly population (≥ 65 years old) in the family	Value
	INDEX	Digital inclusive finance	Digital inclusive finance index	Taking the logarithm
	T	Interaction term	Product of the proportion of elderly people and the digital inclusive finance index (elder_rate*INDEX)	Value
Head-of-family characteristics	age	Age	Age of the family head	Value
	gender	Gender	Gender of the head of the family	0 represents female 1 represents male
	edu	Education	Educational attainment of the head of the family, where a higher value indicates a higher level of education	1–6 represent educational levels, ranging from illiterate/semi-literate to undergraduate degree
	health	Health	The health condition of the head of the family, where a higher numerical value indicates better health	The values 1–5 correspond to the levels of health, from unhealthy to very healthy, respectively 1 represents divorced, 2 represents widowed, 3 represents cohabiting, 4 represents unmarried, 5 represents married (with spouse)
	marriage	Marriage	The marital status of the head of the family	
Family characteristic factors	INCOME	Income	Total family income	Taking the logarithm
	Familysize	Family size	Total number of individuals in the family	Value
	child_rate	Proportion of children	Ratio of the number of children (≤ 16 years old) to the total number of individuals in the family	Value
	address	Residence category	Family category	0 represents urban 1 represents rural
	security	Commercial insurance	Whether the family has purchased commercial insurance	0 represents not purchased 1 represents purchased
	CAR	Vehicle purchase cost	The expenditure of the family on purchasing vehicles	Taking the logarithm
Family Characteristics Factors	business	Sole Proprietorship	Whether the family is a sole proprietorship	0 for No 1 for Yes
	house	Self-Occupied Housing	Whether the family owns a self-occupied housing	0 for No 1 for Yes
Regional factors	GDP	Regional economic level	The economic development level of the region where the family is located	Taking the logarithm

Family-Head-Level Variables: ① Age: Calculated based on the family head's date of birth. ② Gender: Assigned a value of 1 for male family heads and 0 for female family heads. ③ Education Level: The highest education level attained by the family head, assigned values as follows: 1 for illiterate or semi-literate, 2 for the completion of primary school, 3 for the completion of middle school, 4 for the completion of high school, vocational school, technical school, or vocational high school, 5 for the completion of junior college, and 6 for the completion of undergraduate studies. ④ Health Condition: Self-rated health condition of the respondent, assigned values as follows: 1 for perceived unhealthy, 2 for perceived fair, 3 for perceived moderately healthy, 4 for perceived very healthy, and 5 for perceived extremely healthy. ⑤ Marital Status: Marital status of the family head, including five categories: divorced, widowed, cohabiting, unmarried, and married (with spouse), assigned values as follows: 1, 2, 3, 4, and 5, respectively.

Family-Level Variables: ① Income: Includes the family's wage income, transfer income, investment income, and other income. Logarithmic transformation is applied. ② Family Size: Total population of the family. ③ Proportion of Children: The ratio of the population aged 16 and below to the total population of the family. ④ Family Registration Type: Used to classify family types, with a value of 0 assigned for urban families and 1 for rural families. ⑤ Commercial Insurance Ownership: If the family has purchased commercial insurance, a value of 1 is assigned; otherwise, a value of 0 is assigned. ⑥ Vehicle Purchase Expenditure: Expenditure incurred by the family for purchasing vehicles. Logarithmic transformation is applied. ⑦ Self-Employment Status: If the family operates as a self-employed business, a value of 1 is assigned; otherwise, a value of 0 is assigned. ⑧ Homeownership: If the family owns a self-occupied housing unit, a value of 1 is assigned; otherwise, a value of 0 is assigned.

Regional-Level Variable: GDP of the respective area where each family is located.

4.3. Descriptive Statistics of Variables

Table 3 presents the descriptive statistics of the variables. It can be observed that the mean value of financial fragility for the sample families is 0.892, indicating a moderate level of fragility. This suggests that most families have a limited capacity to withstand risk shocks. From the perspective of individual characteristics of the family heads, the mean age of the sample families is 47 years. Family heads in this age group tend to have a rational attitude toward the economic situation of the family and make economic decisions, which enhances the validity of the database and provides strong support for the empirical analysis in this study. The proportion of male-headed families is 52.1%, and the mean value of educational attainment for family heads is 2.854, indicating a generally low level of education among family heads, with an average education level between primary school and junior high school. The mean value of health status for family heads is 2.892, indicating that the overall health condition of family heads is generally good. In terms of family characteristics, the logarithm of the total income for families has a mean value of CNY 10.673 million. The mean value of whether the family is urban or rural is 0.704, indicating that rural families constitute the majority of the surveyed families. The mean value of family size is three people. Around 38.1% of the surveyed families have purchased commercial insurance, indicating a relatively low level of insurance coverage among Chinese families. Furthermore, 83.1% of the families own their residences, indicating a high homeownership rate. Only 13.1% of the families are categorized as self-employed.

Table 3. Descriptive statistics of variables.

	Variable Name	Observations	Mean	Standard Deviation	Minimum	Maximum
Dependent variable	FV	11,967	0.892	0.783	0	2
Independent variable	elder_rate	11,967	0.117	0.243	0	1
Characteristics of the family head	age	11,967	47.823	13.487	22	80
	gender	11,967	0.521	0.500	0	1
	edu	11,967	2.854	1.403	1	6
	health	11,967	2.892	1.178	1	5
	marriage	11,967	4.692	0.909	1	5

Table 3. Cont.

	Variable Name	Observations	Mean	Standard Deviation	Minimum	Maximum
Factors of family characteristics	INCOME	11,967	10.673	1.043	7.601	12.899
	familysize	11,967	3.936	1.758	1	9
	child_rate	11,967	0.156	0.174	0	0.6
	address	11,967	0.704	0.457	0	1
	security	11,967	0.381	0.486	0	1
	CAR	11,967	3.057	4.143	0	14.221
	business	11,967	0.131	0.337	0	1
	house	11,967	0.831	0.375	0	1

5. Model Specification and Empirical Research

5.1. Model Specification

Due to the ordinal nature of the dependent variable “residential family financial fragility” in this study, an ordered probit panel model was selected to empirically examine the impact of population aging on residential family financial fragility and the potential moderating effect of digital inclusive finance.

$$FV_{ijt} = H[\alpha_0 + \alpha_1 old_{ijt} + \alpha_2 index_{jt} + \alpha_3 old_{ijt} \times index_{jt} + \alpha_4 X_{ijt} + \varepsilon_i] \quad (1)$$

$H(\bullet)$ is a non-linear function, and its specific form is as follows:

$$H(FV^*_{ijt}) = \begin{cases} 1 & \dots \dots FV^*_{ijt} < \eta_1 \\ 2 & \dots \dots \eta_1 \leq FV^*_{ijt} \leq \eta_2 \\ N & \dots \dots FV^*_{ijt} \geq \eta_{N-1} \end{cases}$$

FV^*_{ijt} in the above equation represents the latent financial fragility of families, and it satisfies the following:

$$FV^*_{ijt} = \alpha_0 + \alpha_1 old_{ijt} + \alpha_2 index_{jt} + \alpha_3 old_{ijt} \times index_{jt} + \alpha_4 X_{ijt} + \varepsilon_i \quad (2)$$

η_i represents different thresholds of the latent variable FV^* .

The term FV_{ijt} represents the financial fragility of the resident family, where i represents the family, j represents the district in which the family is located, and t represents the sample time. The indicators of population aging old_{ijt} and the digital inclusive finance index $index_{jt}$ are the core explanatory variables in this study. The interaction term α_3 between the indicators of population aging and digital inclusive finance is used to examine the moderating effect of digital inclusive finance on the financial fragility of aging families. If the coefficient α_3 of the interaction term is opposite in sign to the coefficient α_1 of the population aging indicator, it indicates that digital inclusive finance significantly mitigates the financial fragility of aging families. X_{ijt} represents the control variables, and ε_i represents the random error term.

This study empirically investigated the following questions based on the aforementioned model: (1) How does population aging affect the financial fragility of resident families? What is the impact of the individual characteristics of family members and family-level factors on the financial fragility of resident families? (2) What is the effect of digital inclusive finance on the financial fragility of aging families?

5.2. Regression Results and Analysis

In this study, regression analysis was conducted using STATA 17.0, and the results are presented in Table 4. Columns (1) and (2) show the empirical results of the ordinary

ordered least-squares (OLS) model, while columns (3) and (4) present the empirical results of the ordered probit panel model. Neither column (1) nor (3) include any control variables.

Table 4. Regression results of the baseline model.

Variables	(1)	(2)	(3)	(4)
elder_rate	2.989195 ** (0.027)	2.706267 ** (0.043)	7.303487 *** (0.010)	6.263547 ** (0.031)
INDEX	−0.5039309 *** (0.000)	−0.2543112 *** (0.001)	−0.9040625 *** (0.000)	−0.5133208 *** (0.001)
T	−0.6022952 ** (0.016)	−0.5275034 ** (0.032)	−1.452245 *** (0.006)	−1.217779 ** (0.023)
age		0.0069366 ** (0.072)		0.0148605 * (0.073)
AGE		−0.0001004 ** (0.012)		−0.0002085 ** (0.016)
gender		−0.0032959 (0.817)		−0.0190272 (0.540)
address		0.0960717 *** (0.000)		0.2241483 *** (0.000)
marriage		−0.0286517 *** (0.000)		−0.0555001 *** (0.001)
health		−0.0286517 *** (0.000)		−0.0555001 *** (0.001)
edu		−0.0555417 *** (0.000)		−0.1176605 *** (0.000)
business		0.0673672 *** (0.002)		0.1432588 *** (0.002)
familysize		0.0285225 *** (0.000)		0.0597089 *** (0.000)
security		−0.0545924 *** (0.002)		−0.1010759 *** (0.007)
child_rate		0.0824347 * (0.079)		0.2008056 ** (0.046)
house		0.0100209 (0.610)		0.0155632 (0.710)
CAR		0.0187027 *** (0.000)		0.0400923 *** (0.000)
GDP		−0.0826964 *** (0.000)		−0.17 *** (0.000)

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The same applies to the following tables.

According to the regression results mentioned above, both before and after including control variables, as well as using the ordinary ordered least-squares (OLS) model for regression analysis, the coefficient of the population aging variable is significantly positive at the 5% level. This indicates that the presence of elderly individuals in the family contributes to negative impacts on the financial fragility of residents' families, and as the proportion of the elderly population increases, the financial fragility of residents' families also increases. Specifically, for every one-unit increase in the proportion of the elderly population in residents' families, the financial fragility of the families increases by 2.9 units, which supports hypothesis H₁ proposed earlier. Population aging leads to increased health risks in residents' families, results in higher unexpected expenses, and influences labor

participation behavior, resulting in increased income uncertainty and negative effects on the financial fragility of residents' families. Liao (2019). In Table 4, it can also be observed that the coefficient of the interaction term between population aging and inclusive finance is significantly negative. This indicates that inclusive finance effectively mitigates the adverse effects of population aging on the financial fragility of residents' families, which supports hypothesis H₂ proposed earlier. On the one hand, inclusive finance reduces the barriers and transaction costs of financial services, promotes entrepreneurial and investment activities in residents' families, helps increase income, and enables better coping with the negative impacts of aging on financial fragility. On the other hand, the development of inclusive finance promotes the dissemination and popularization of risk-hedging tools such as insurance, which helps reduce unexpected expenses and attenuates the risk impact of population aging on residents' families.

Simultaneously, the regression results in columns (1)–(4) of Table 4 consistently show negative and statistically significant coefficients for the inclusive finance variable at the 1% level. This indicates that the development of inclusive finance helps alleviate the financial fragility of residents' families, which confirms hypothesis H₂. Although digital financial inclusion can effectively alleviate household financial vulnerability caused by aging, the absolute value of this coefficient is small, and the mitigating effect of digital financial inclusion still needs to be further strengthened. From the regression coefficients of the control variables in column (4) of Table 4, it can be observed that factors such as rural family registration, a larger family size, a higher proportion of young children (leading to childcare pressure), expenses related to vehicle purchases, and being a self-employed family significantly increase the financial fragility of residents' families. Conversely, the good health condition of the family head, a higher level of education, the purchase of commercial insurance by the family, and a higher economic development level of the region where the family is located significantly reduce the financial fragility of residents' families.

5.3. Mechanism Analysis

In the theoretical analysis in Chapter 3, the potential impact of credit constraints and family income as mediating variables on family financial fragility was analyzed. Here, we adopt the mediation effect model proposed by Fang Jie, Wen Zhonglin, and Zhang Minqiang to examine the underlying mechanisms (Fang et al. 2017). The model is as follows:

$$FV^*_{ijt} = \alpha_0 + \alpha_1 old_{ijt} + \alpha_2 index_{jt} + \alpha_3 old_{ijt} \times index_{jt} + \alpha_4 X_{ijt} + \varepsilon_i \quad (3)$$

$$Y = \beta_0 + \beta_1 old_{ijt} + \beta_2 index_{jt} + \beta_3 old_{ijt} \times index_{jt} + \beta_4 X_{ijt} + \varepsilon \quad (4)$$

$$FV^*_{ijt} = \eta_0 + \eta_1 old_{ijt} + \eta_2 index_{jt} + \eta_3 old_{ijt} \times index_{jt} + \eta_4 Y + \eta_5 X_{ijt} + \varepsilon \quad (5)$$

In Equations (4) and (5), Y represents the mediating variable, which represents credit constraints and family income. Equation (4) is used to examine the impact of aging and digital inclusive finance on credit constraints and family income. This study focuses on the significance of coefficients β_1 , β_2 , and β_3 . Equation (5) is used to examine the mediating mechanisms of credit constraints and family income in the moderating effect of digital inclusive finance on the financial fragility of aging families. This study focuses on the significance of coefficients η_1 , η_3 , and η_4 . By comparing and analyzing these equations with the baseline regression model mentioned earlier, we can examine the pathways through which aging affects family financial fragility and the mediating pathways through which digital inclusive finance plays a moderating role.

5.3.1. Credit Constraints

This section verifies the mediating effect of credit constraints on family financial fragility by using the ordered probit panel model for empirical analysis. In both the 2016 and 2018 CFPS surveys, the question "Have you ever been rejected when borrowing a large amount of money?" was asked. The response "Yes" is assigned a value of 1, indicating that the family is

subject to credit constraints, while the response “No” is assigned a value of 0, indicating that the family is not subject to credit constraints. The empirical results are presented in Table 5.

Table 5. The impact of credit constraints on family financial fragility.

Variables	(1)	(2)	(3)
	FV_{ijt}^*	Refuse	FV_{ijt}^*
elder_rate	6.092386 ** (0.036)	8.123412 * (0.076)	5.801671 ** (0.043)
INDEX	−0.51391 *** (0.001)	−0.7963339 *** (0.000)	−0.4359897 *** (0.005)
T	−1.205078 ** (0.024)	−1.568 * (0.064)	−1.146365 ** (0.030)
refuse			0.5078906 *** (0.000)
Control variables	Control	Control	Control
Observations	11,967	11,967	11,967

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The same applies to the following tables.

In Table 5, column (2) presents the regression results with credit constraints as the dependent variable. It can be observed that aging significantly intensifies the credit constraints faced by households. The development of digital inclusive finance can alleviate the credit constraints faced by households. The interaction term between digital inclusive finance and the aging index has a significantly negative regression coefficient, which is opposite to the coefficient of the aging index. This suggests that the development of digital inclusive finance helps mitigate the negative impact of population aging on household credit constraints. This also implies that policies promoting financial inclusion are particularly effective for those groups of individuals most commonly excluded from financing channels (Allen et al. 2021). Among them, the influence coefficient of aging on household credit constraints is the largest, indicating that the enhancement effect of aging on household credit constraints is much stronger than the mitigation effect of digital inclusive finance. Column (3) presents the regression results after adding credit constraints as an explanatory variable to the baseline model, and the results are consistent with those in column (2). Based on the basic principles of the mediation effect test equation, it can be inferred that there exists a mediating effect of credit constraints, and hypothesis H₃ is validated. Generally speaking, the development of digital inclusive finance can lower the entry barriers in the financial market for households, thereby alleviating the credit constraints they face and reducing the likelihood of households falling into financial distress. This, to some extent, diminishes the negative effects of aging on household financial vulnerability.

5.3.2. Family Income

In this section, we will examine the impact of family income as a mediating variable on family financial fragility. The regression process is similar to the previous section, and the results are shown in Table 6. Specifically, the regression results in column (2) indicate that aging has a significant negative effect on household income; however, fintech can promote the development of inclusive finance, increasing family income (Allen et al. 2021). Moreover, through the size of the coefficient, it can be seen that the promoting effect of digital financial inclusion is far less than the inhibiting effect brought by aging. Moreover, the coefficient of the interaction term between the aging index and digital financial inclusion is significantly positive and opposite to the coefficient of the aging index, suggesting that the development of digital financial inclusion helps mitigate the negative effects of aging on household income. This is consistent with the theoretical analysis in Chapter 3. The regression results in column (3) show that, after introducing household

income into the ordered probit panel model, the regression result of household income on financial vulnerability is significantly negative. For every unit increase in the natural logarithm of household income, the financial vulnerability index decreases by 29.0%. This indicates that household income is an important factor affecting financial vulnerability, consistent with previous research (Jappelli et al. 2013). The absolute value of the regression coefficient of the aging index on household financial vulnerability in column (3) is much smaller than the absolute value of the basic regression coefficient in column (1) and is not significant. Meanwhile, the absolute values of the regression coefficients of digital financial inclusion and its interaction term with the aging index also decrease significantly and are not significant. This suggests that household income plays a strong mediating role in the negative effects of aging on household financial vulnerability and in the moderating effects of digital financial inclusion on alleviating the financial vulnerability caused by aging. This confirms hypothesis H4 mentioned earlier. Digital financial inclusion helps alleviate the financial constraints faced by households. By promoting household participation in the financial market, enhancing the diversification and effectiveness of household asset portfolios, increasing property income, and encouraging household entrepreneurship, it increases household income, providing an important channel to mitigate the negative impact of aging on household financial vulnerability. Digital inclusive finance is the result of the integration of financial technology and inclusive finance. Financial technology has promoted the development of inclusive finance in China. It helps alleviate friction in the local credit supply of the credit market and extends credit availability to small businesses with lower credit scores (Hau et al. 2019). At the same time, the development of digital inclusive finance has provided convenience for consumers with lower credit scores and incomes (Dolson and Jagtiani 2021).

Table 6. The impact of family income on family financial fragility.

Variables	(1)	(2)	(3)
	FV_{ijt}^*	INCOME	FV_{ijt}^*
elder_rate	6.092386 ** (0.036)	−11.58016 *** (0.000)	2.601164 (0.375)
INDEX	−0.51391 *** (0.001)	1.397574 *** (0.000)	−0.1554878 (0.324)
T	−1.205078 ** (0.024)	2.06193 *** (0.000)	−0.5850493 (0.280)
INCOME			−0.2904272 *** (0.000)
Control variables	Control	Control	Control
Observations	11,967	11,967	11,967

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The same applies to the following tables.

5.4. Endogeneity Test

In view of the fact that the explained variable, household financial vulnerability, is a micro variable, the reverse impact on the macro variable, digital financial inclusion, is small, but there may be reverse causality. In addition to the above control variables, household financial vulnerability may also be affected by personal financial habits, consumption ideas, and the behavior of people around the family, and the impact of these uncontrollable factors will lead to the problem of missing variables. Therefore, the instrumental variable method was used to eliminate their influence.

In most of the literature, the number of phone calls per 100 people (Qian et al. 2020), the Internet usage rate (Feng et al. 2020), and the distance from Hangzhou City (Zhang et al. 2020b) are used as instrumental variables. Since the number of phone calls per 100 people and the Internet usage rate measure the use of the Internet in a region, the use of the

Internet may affect households' access to information, thus affecting households' borrowing behavior and financial literacy, which will affect household financial vulnerability. Based on this, the distance between the capital city of the province where the family lives and Hangzhou was selected as the instrumental variable of digital inclusive finance to carry out endogenous processing. As the development center of digital inclusive finance is Hangzhou, and the farther away from Hangzhou, the more difficult it will be to promote, the digital inclusive finance index will spread to the whole country with Hangzhou at the center. According to Xie et al. (2018), the development level of digital inclusive finance in China is basically decreasing from the southeast coastal areas to the inland areas. Therefore, the digital financial inclusion index shows a negative correlation with the distance from the region to Hangzhou. On the other hand, the distance variable is completely exogenous and has nothing to do with the regional economic level. At the same time, it has nothing to do with family characteristics and individuals, so it will not affect the financial vulnerability of families. Therefore, it is appropriate to choose it as the instrumental variable of the core variable, digital financial inclusion, in this paper.

Considering the scientific nature of the experiment, in order to overcome the endogeneity problem of digital financial inclusion mentioned above, the conditional mixed process estimation method (CMP) was used to test the possible endogeneity problem in this study and refers to the existing research (Roodman 2011). Combining instrumental variables with the CMP method can overcome the endogeneity problem of the ordered probit model. Based on this, the distance from Hangzhou City is taken as the instrumental variable, and the regression results of the CMP method are shown in Table 7. Among them, the first column shows the impact of digital inclusive finance on the financial vulnerability of Chinese households, and the second column takes digital inclusive finance as the dependent variable, the distance from Hangzhou as the independent variable, and the results obtained after maintaining the above control variables. The results show that digital financial inclusion has a negative impact on household financial vulnerability at the 1% level, indicating that the conclusion reached by the above baseline regression analysis is stable. In addition, the significance of the control variables after considering the endogeneity problem is basically consistent with that described above. In addition, in order to confirm that the instrumental variables selected in this study are scientific, the problem of weak instrumental variables was tested by using the two-stage least-square method. Since the F-value of the first stage is 2233.51, which is greater than the empirical value of 10, and the result is at least significant at the 1% level, it basically indicates that there are no weak instrumental variables. Since atanhrho , the auxiliary estimation parameter of household financial vulnerability, is significantly non-zero at the 1% level, it indicates that there is a significant correlation between the two equations constructed with instrumental variables in the simultaneous equation model, which means that the CMP method is more effective than separate estimation. Therefore, the endogeneity test shows that the estimation results using the CMP method are reliable.

Table 7. Excluding samples from Zhejiang Province.

Variables	Conditional Mixed Process Estimation (CMP)	
	FV_{ijt}^*	INDEX
INDEX	−0.2442 *** (0.020)	
distance		−0.2084 *** (0.002)
atanhrho		0.0295 ***
Control variables	Control	Control
Observations	11,967	11,967
F	2233.51 ***	2233.51 ***

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The same applies to the following tables.

5.5. Robustness Test

5.5.1. Excluding Samples from Zhejiang Province

The development center of the digital inclusive finance index is located in Hangzhou, Zhejiang Province, at Ant Group. Therefore, Hangzhou is the region with the highest digital inclusive finance index. In order to avoid the influence of extreme values, samples from Zhejiang Province were excluded from the total sample, and empirical research was conducted on the remaining samples. The results are shown in Table 8. It can be observed that even after excluding samples from Zhejiang Province, the regression results remain significant. The direction and significance of the explanatory variables' impacts on the dependent variable have not changed significantly, indicating that the results are robust.

Table 8. Excluding samples from Zhejiang Province.

Variables	(1)	(2)
	FV_{ijt}^*	FV_{ijt}^*
elder_rate	6.092386 ** (0.036)	5.45594 * (0.064)
INDEX	−0.51391 *** (0.001)	−0.4563268 *** (0.004)
T	−1.205078 ** (0.024)	−1.086441 ** (0.046)
Control variables	Control	Control
Observations	11,967	11,967

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The same applies to the following tables.

5.5.2. Using Different Digital Inclusive Financial Indexes

The independent variable digital inclusive finance index was replaced with the coverage breadth index COVERAGE. The empirical results in column (1) of Table 9 show that an increased coverage level significantly reduces the level of financial fragility among families. The coverage index represents the extent of digital inclusive finance coverage, indicating that government departments should continue to invest in relevant financial infrastructure to further expand the coverage of digital inclusive finance. This would enable more people to benefit from inclusive financial services. Using the depth index USAGE instead of the digital inclusive financial index as the independent variable led to the empirical results shown in column (2) of Table 9. The results show that the depth of use significantly reduces the financial vulnerability of households, and the depth of use focuses more on users' effective demand for digital inclusive financial services. This suggests that the government should actively guide financial institutions to innovate and introduce more differentiated and diverse financial products and services to meet the needs of a wider range of people. At the same time, financial institutions need to increase the promotion of financial knowledge and raise residents' awareness of risk prevention, helping them better identify the valid demand for financial services and significantly improving the efficiency of policy implementation. To sum up, when using two different digital inclusive financial indexes for empirical analysis, the results remain robust.

Table 9. Switching to different digital inclusive financial indexes.

Variables	(1)	(2)
	FV^*_{ijt}	FV^*_{ijt}
elder_rate	4.279454 * (0.056)	2.601164 (0.375)
COVERAGE	−0.4327 *** (0.001)	−0.1554878 (0.324)
USAGE		−0.5850493 (0.280)
T	−0.8922086 ** (0.035)	−0.5984728 ** (0.024)
Control variables	Control	Control
Observations	11,967	11,967

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The same applies to the following tables.

5.5.3. Switching Regression Methods

Whether using the ordered probit panel model or ordinary ordered OLS regression, as long as the causal relationships between variables have solid theoretical or logical foundations, the research conclusions obtained will not differ significantly. In this section, we will switch to ordinary ordered OLS regression to repeat the empirical analysis process described earlier. The results are shown in column (1) of Table 10, and the direction and significance of the effects of each independent variable have not changed significantly. The results after switching to the ordered Logit model are shown in column (2) of Table 10, and the empirical results remain robust.

Table 10. Using different regression methods.

Variables	(1)	(2)
	FV^*_{ijt}	FV^*_{ijt}
	OLS	OLOGIT
elder_rate	2.626343 ** (0.049)	10.73475 ** (0.033)
INDEX	−0.2559106 *** (0.001)	−0.8852677 *** (0.001)
T	−0.5219166 ** (0.034)	−2.119071 ** (0.022)
Control variables	Control	Control
Observations	11,967	11,967

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The same applies to the following tables.

5.6. Heterogeneity Analysis

5.6.1. Heterogeneity Analysis Based on Family Head's Gender

Considering the gender differences in daily caregiving behavior, particularly in the investment in the elderly population over 65, the gender of the family head also needs to be taken into account when examining the impact of population aging on family financial fragility. Referring to the gender of the family head, this study divided the total sample into two parts for separate empirical analysis. The regression results are presented in Table 11.

Table 11. Heterogeneity analysis based on family head's gender.

Variables	Female	Male
elder_rate	10.66789 ** (0.013)	2.383243 (0.549)
INDEX	−0.2170949 (0.319)	−0.8106103 *** (0.000)
T	−2.051181 *** (0.009)	−0.5168633 (0.481)
Control variables	Control	Control
Observations	5727	6240

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The same applies to the following tables.

Based on the empirical results in Table 11, it can be observed that in families with female heads, the regression coefficient of the aging indicator on family financial fragility is significantly positive. On the other hand, in families with male heads, the regression coefficient of the aging indicator on family financial fragility is positive but not significant, and the coefficient is significantly higher in families with female heads than in families with male heads. The absolute value and significance of the regression coefficient of the interaction term between digital inclusive financial and the aging indicator are also higher in families with female heads. This indicates that the impact of population aging on family financial fragility is greater in families with female heads, and the moderating effect of digital inclusive finance is stronger. Previous studies have shown that women tend to provide more care for the elderly compared to men (Horowitz 1985), and the opportunity cost of providing care for the elderly is higher for women (Lu and Peng 2021). The ability of families to cope with unexpected shocks decreases as these opportunity costs increase, leading to an increased probability of family financial fragility. In terms of enjoying the digital dividends brought by digital inclusive finance, families with male heads have higher marginal effects, and the results are more significant. However, in terms of mitigating the negative impact of population aging on family financial fragility, families with female heads have greater marginal effects. This indicates that, compared to families with male heads, digital inclusive finance has a greater positive impact on mitigating financial fragility in families with female heads in the context of population aging.

5.6.2. Heterogeneity Analysis Based on Family's Purchase of Commercial Insurance

When families face financial pressure due to uncertain risks, commercial insurance can promptly compensate for the cash-flow gap, thereby enhancing the ability of families to withstand uncertain risks and reducing their financial fragility. Therefore, the purchase of commercial insurance can improve families' ability to cope with unexpected shocks, thus helping them mitigate the negative impact of population aging on family finances. Based on families' purchases of commercial insurance, this study divided the sample into groups to empirically examine whether the purchase of commercial insurance helps mitigate the negative impact of population aging on family finances and further investigated whether the moderating effect of digital inclusive finance has changed.

From the empirical results in columns (2) and (3) of Table 12, it can be observed that families that have purchased commercial insurance experience a smaller negative impact of population aging on their financial fragility, but the results are not significant. On the other hand, families that have not purchased commercial insurance face a larger negative impact of population aging on their financial fragility, and the results are significant. This indicates that the purchase of commercial insurance can mitigate the negative impact of population aging on family financial fragility. Furthermore, in terms of the moderating effect of digital inclusive finance on the negative impact of population aging on family finances, the marginal effects and significance for families without commercial insurance are higher compared to those with commercial insurance.

Table 12. Heterogeneity analysis based on the purchase of commercial insurance by family.

Variables	Having Commercial Insurance	Not Having Commercial Insurance
elder_rate	3.930703 (0.550)	9.002077 *** (0.010)
INDEX	−0.5303852 ** (0.018)	−0.4490016 * (0.061)
T	−0.6708572 (0.575)	−1.781821 *** (0.006)
Control variables	Control	Control
Observations	4558	7409

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The same applies to the following tables.

6. Conclusions and Policy Recommendations

6.1. Research Findings

From the perspective of population aging, this study empirically analyzed the relationship between population aging, family financial fragility, and digital inclusive finance using data from the China Family Panel Studies (CFPS) in 2016 and 2018, as well as the digital inclusive finance index. The following conclusions are drawn: (1) Population aging increases the probability of family financial fragility. (2) The baseline model shows that the use of digital inclusive finance mitigates financial fragility in aging families. (3) A mechanism analysis reveals that digital inclusive finance alleviates credit constraints and increases family income, thereby mitigating the negative impact of population aging on family financial fragility. (4) A heterogeneity analysis indicates that the negative impact of population aging on family financial fragility is greater in female-headed families, and the mitigating effect of digital inclusive finance is stronger in such families. Additionally, the purchase of commercial insurance can mitigate the negative impact of population aging on family financial fragility. Furthermore, the marginal effects and significance of digital inclusive finance in mitigating the negative impact of population aging are higher for families without commercial insurance compared to those with insurance.

6.2. Policy Recommendations

6.2.1. Family-Level Recommendations

(1) Plan and save for retirement in advance

The results in this paper show that aging increases the financial vulnerability of households, and how households deal with this challenge is very important. Nowadays, the digital trend is irreversible, so individual residents should actively change their minds and adapt to the changes in real life brought by the Internet, big data, and artificial intelligence. Research shows that early investment and savings will bring greater returns due to the compound interest effect, providing financial security in old age (Goda et al. 2017). As the main wealth manager and decision maker driving financial behavior in the family, the head of the household has the responsibility and obligation to take the initiative to learn relevant financial knowledge to improve their financial literacy, make long-term financial plans in advance, and save pensions to better withstand the impact of aging on the financial vulnerability of the family.

(2) Adjust the ratio of bank savings deposits and purchase insurance products

The empirical research in this paper has found that aging has a smaller impact on the financial fragility of families that have purchased commercial insurance, and digital inclusive finance has a greater mitigating effect on the financial fragility of families that have not purchased commercial insurance. Insurance products provide an effective means for families to hedge risks when they encounter related risks. Therefore, families should actively shift their mindsets, raise their awareness of insurance, and, based on their personal

and family financial conditions, appropriately reduce the ratio of bank savings deposits. Instead, a portion of the savings should be allocated to purchase insurance products, effectively transferring family risks through the use of insurance products.

6.2.2. Suggestions for Financial Institutions

(1) Enrich digital inclusive financial products and services

The research findings of this study indicate that the impact of aging on financial fragility is smaller for families with commercial insurance. Although there is a relatively wide range of existing digital inclusive financial products and services, there is still a lack of suitable options for certain vulnerable groups. Therefore, financial institutions should gain a deeper understanding of the financial service needs of different social groups and design more differentiated inclusive financial products and services to meet the diverse demands of these groups. In terms of form, multi-level financial service channels should be established both online and offline, and financial knowledge training seminars should be regularly conducted to promote financial literacy among the public. In terms of content, the promotion of protection-oriented financial products should be increased to ensure that families fully understand the important role such products play in safeguarding financial security.

(2) Strengthen the integration of traditional financial institutions and digital technology

The research conclusions of this study demonstrate that digital inclusive finance can alleviate the impact of aging on families' financial fragility. Therefore, traditional financial institutions should continue to strengthen their integration with digital technology. They should gradually complete their digital transformation, ensuring cost control and security, to further enhance the convenience of financial services. In doing so, traditional financial institutions should shift their development mindset. They should enhance cooperation with Internet companies and network operators, actively building cross-platform financial service networks. This approach will enhance inclusivity in the industry. It will also continuously introduce innovative digital inclusive financial products and services, providing more opportunities for the general public to make informed asset allocation decisions. Such initiatives will reduce the probability of financial fragility for families.

6.2.3. Government-Level Recommendations

(1) Accelerate infrastructure development and enforce financial regulations

The research findings in this paper indicate that digital inclusive finance can reduce the financial fragility of families by alleviating credit constraints and increasing family income. Therefore, to ensure that digital inclusive finance services can benefit more residents, especially those in rural areas, the government should actively improve the financial environment and increase fiscal support for the development of digital inclusive finance. Additionally, efforts should be made to actively build and improve infrastructure, such as mobile Internet connectivity. Furthermore, government agencies should establish and enhance a robust regulatory framework for digital inclusive finance, ensuring comprehensive and prudent oversight of all aspects involved. This will not only regulate financial transactions but also protect the majority of small and medium-sized investors in the financial market, reducing the probability of families facing financial difficulties.

(2) Proactively address the aging population trend and strengthen insurance system development

Government agencies should fully recognize the profound negative impact of aging on family finances and prioritize addressing the potential financial risks faced by families. Firstly, the government needs to proactively respond to the aging population trend by continuously improving the social security system and healthcare insurance system. In addition to basic protection, particular attention should be given to enhancing coverage for health risks among the elderly, thereby reducing the financial impact of aging on families.

Secondly, it is crucial to strengthen the development of the insurance system. This includes incentivizing commercial insurance institutions to continuously optimize their services and improve service efficiency. Moreover, innovative and customized insurance products should be developed to meet the diverse financial needs of different types of families, enhancing their ability to cope with financial risks.

6.3. Limitations and Outlook of the Research

This study attempts to comprehensively analyze the impact of population aging and digital inclusive finance on the financial fragility of families from multiple perspectives. However, due to limitations in our knowledge, academic level, and time constraints, there are areas in this paper that may be incomplete or not sufficiently in-depth. Firstly, considering the availability of data, this study only used data at the provincial level, and further research could delve into the municipal level. The sample length chosen for studying the impact of population aging on the financial fragility of families is also limited. Secondly, there is currently no unified standard for measuring the financial fragility of families in academia, and the data obtained through public sources are limited. Different methods for constructing indicators of family financial fragility may lead to different conclusions. Therefore, based on the analysis above, future research can continue to improve data availability, refine research methods, and explore the issues addressed in this paper in greater depth.

Author Contributions: Conceptualization, X.W.; methodology, X.W.; software, X.W.; validation, X.W.; formal analysis, X.W.; investigation, X.W.; resources, X.W.; data curation, X.W.; writing—original draft preparation, X.W.; writing—review and editing, X.W. and Z.M.; visualization, X.W.; supervision, Z.M.; project administration, X.W.; funding acquisition, X.W. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Data will be made available on request.

Conflicts of Interest: The authors declare no conflict of interest.

Note

- ¹ Data source: Peking University Digital Finance Research Center website: <https://idf.pku.edu.cn/zsbz/515313.htm> (accessed on 21 March 2021).

References

- Abid, Abidullah, and Muhammad Hakimi Mohd Shafia. 2018. The Determinants of Family financial fragility in Malaysia and its Effect on Low-Income Groups. *Journal of Emerging Economies and Islamic Research* 6: 32–43. [CrossRef]
- Albacete, Nicolás, and Peter Lindner. 2013. Family Fragility in Austria—A Microeconomic Analysis Based on the Family Finance and Consumption Survey. *Financial Stability Report* 20: 57–73.
- Allen, Franklin, Asli Demirguc-Kunt, and Leora Klapper. 2016. The foundations of financial inclusion: Understanding ownership and use of formal accounts. *Journal of Financial Intermediation* 27: 1–30. [CrossRef]
- Allen, Franklin, Gu Xian, and Jagtiani Julapa. 2021. A survey of fintech research and policy discussion. *Review of Corporate Finance* 1: 259–339. [CrossRef]
- Ampudia, Miguel, Has van Vlokhoven, and Dawid Zochowski. 2014. Financial fragility of euro area households. *Journal of Financial Stability* 27: 250–62. [CrossRef]
- Ba, Shusong, Miao Wang, and Chenglin Li. 2023. The impact of aging on Household Asset Allocation: A literature Review. *New Finance* 23: 28–34.
- Banerjee, Abhijit V., and Esther Duflo. 2014. Do firms want to borrow more? *Testing credit constraints using a directed lending program. Review of Economic Studies* 81: 572–607.
- Bayoumi, Tamim. 1993. Financial Deregulation and Family Saving. *Journal of Financial Economics* 101: 449–72.
- Brunetti, Marianna, Elena Giarda, and Costanza Torricelli. 2016. Is Financial Fragility a Matter of Illiquidity? *An Appraisal for Italian Families. Social Science Electronic Publishing* 62: 34–40.
- Campbell, John Y., and N. Gregory Mankiw. 1993. The response of consumption to income: A cross-country investigation. *European Economic Review* 19: 44–47.

- Chang, Yuchun Regina, Sherman D. Hanna, and Jessie Fan. 1993. *Emergency Fund Levels of Families: Is Family Behavior Rational?* Tarpon Springs: American Council on Consumer Interests.
- Chen, Ping, and Shuhua Wang. 2022. Digital Financial Inclusion, Digital Divide and multidimensional relative poverty: From the perspective of aging. *Exploration of Economic Problems* 22: 73–90.
- Chen, Yuping, Zhe Li, and Shijun Ding. 2008. Economic cost analysis of serious illness of rural labor Force in poor areas: Evidence from Hong 'an County, Hubei Province. *Chinese Rural Economy* 8: 67–73.
- Christelis, Dimitrios, Tullio Jappelli, Omar Paccagnella, and Guglielmo Weber. 2009. Income, Wealth and Financial Fragility in Europe. *Journal of European Social Policy* 19: 359–76. [\[CrossRef\]](#)
- Dolson, Erik, and Julapa Jagtiani. 2021. *Which Lenders Are More Likely to Reach Out to Underserved Consumers: Banks vs. Nonbanks vs. Fintechs?* Research Working Paper, forthcoming in March 2021. Philadelphia: Federal Reserve Bank of Philadelphia.
- Fan, Meng, and Jinping Dai. 2022. Aging and Family Financial Vulnerability: A Study on the Response Path under the Empowerment of Digital Finance. *Modern Finance and Economics (Journal of Tianjin University of Finance and Economics)* 33: 63–79.
- Fang, Jie, Zhonglin Wen, and Minqiang Zhang. 2017. An analysis of the Mediating Effect of Category Variables. *Psychological Science* 40: 471–77.
- Feng, Dawei, Mengtao Gao, and Li Zhou. 2020. Digital financial inclusion and residential entrepreneurship: Evidence from the Survey of Labor Dynamics in China. *Financial Economics Research* 35: 91–103.
- Fu, Xinan, Shiyong Qu, Boping Tian, and Yanpeng Li. 2020. A Study on the financial Assets Decision of elderly Households in China Based on the perspective of health Shock. *Forecast* 39: 83–89.
- Gao, Mengtao, Li Gan, Lixin Xu, and Yang Yao. 2006. The income capacity of peasant households and village-level democracy under the impact of health risks. *Chinese Population Science* 6: 21–32.
- Goda, Gopi Shah, Colleen Flaherty, and Aaron J. Manchester. 2017. What will my account really be worth? *Experimental evidence on how retirement income projections affect saving*. *Journal of Public Economics* 155: 80–92.
- Hau, Harald, Yi Huang, Hongzhe Shan, and Zixia Shen. 2019. *FinTech Credit and Entrepreneurial Growth*. University of Geneva Working Paper. Geneva: University of Geneva.
- He, Guanlin. 2022. *Research on the Influence of Family Risk on Financial Asset Allocation*. Chengdu: Sichuan University.
- Horowitz, Amy. 1985. Sons and Daughters as Caregivers to Older Parents: Differences in Role Performance and Consequences. *Gerontologist* 25: 612–17. [\[CrossRef\]](#) [\[PubMed\]](#)
- Hu, Zhongliang. 2016. Gene, Cognitive Ability and Family Financial Decision-making: A Literature Analysis. *Journal of Guizhou University of Finance and Economics* 16: 39–47.
- Huang, Jinlao. 2001. On Financial Vulnerability. *Finance Research* 11: 41–49.
- Huang, Manyu, and Fanhui Zeng. 2021. An analysis of the spatial spillover effect of Digital inclusion Finance on entrepreneurial activity. *Soft Science* 35: 14–18.
- Jappelli, Pagano, Marco Pagano, and Marco Di Maggio. 2013. Households' indebtedness and financial fragility. *Journal of Financial Management Markets and Institutions* 22: 34–45.
- Jian, Binhui, and Tingting Xu. 2019. Family population age structure, pension insurance and family financial asset allocation. *Financial Development Research* 19: 32–39.
- Kapoor, Aditi. 2014. Financial inclusion and the future of the Indian economy. *Futures* 56: 35–42. [\[CrossRef\]](#)
- Kim, Hyun Jeong, Dongyeol Lee, Jong Chil Son, and Min Kyu Son. 2014. Family indebtedness in Korea: Its causes and sustainability. *Japan & the World Economy* 29: 59–76.
- La Cava, Gianni, and John Simon. 2005. Family Debt and Financial Constraints in Australia. *Australian Economic Review* 38: 55–60. [\[CrossRef\]](#)
- Li, Bo, and Taihui Zhu. 2020. Debt Leverage, Financial literacy and Household Financial Vulnerability: An Empirical analysis based on the China Household Tracking Survey CFPS 2014. *International Finance Research* 2: 25–34.
- Li, Guanhua. 2021. *Research on Household Debt Risk in China*. Beijing: University of International Business and Economics.
- Liao, Yuhang. 2019. Impact of health risk on Labor participation: A counterfactual causal analysis. *Population and Economy* 19: 30–46.
- Lu, Mingyang, and Xizhe Peng. 2021. A study on the Opportunity Cost of family care for the elderly. *Social Sciences of Ningxia* 39: 118–31.
- Lusardi, Annamaria. 2011. *Americans' Financial Capability*. Cambridge, MA: National Bureau of Economic Research, Inc., vol. 10, pp. 29–32.
- Marchettini, Daniela, and Mindaugas Leika. 2017. A Generalized Framework for the Assessment of Family financial fragility. *IMF Working Papers* 81: 49–52.
- Meng, Defeng, Yan Weixiang, and Liu Zhiyou. 2019. Financial Literacy and Household Financial Vulnerability. *Shanghai Finance* 8: 1–13.
- Michelangeli, Valentina, and Mario Pietrunti. 2014. A Microsimulation Model to Evaluate Italian Families' Financial Fragility. *Questioni Di Economia E Finanza* 7: 53–79.
- Qi, Mingzhu, and Chenggong Zhang. 2019. The Effect of Age on the Efficiency of Household financial asset allocation under the background of aging. *Population and Economy* 20: 54–66.
- Qian, Haizhang, Yunqing Tao, Songwei Cao, and Yuyang Cao. 2020. Theoretical and Empirical Study on the Development of Digital Finance in China and Economic Growth. *Quantitative Economics and Technical Economics Research* 37: 26–46.

- Roodman, David M. 2011. Fitting Fully Observed Recursive Mixed-Process Models with CMP. *Stata Journal* 11: 159–206. [\[CrossRef\]](#)
- Ruan, Jianhong, and Ye Huan. 2020. Research on the Current Situation and Influencing Factors of leverage ratio Ratio of Chinese Residents. *Financial Research* 1: 18–33.
- Teng, Lei, and Degong Ma. 2020. Can digital finance promote high-quality development? *Statistical Research* 37: 80–92.
- Vandone, Luisa, Emanuele Bacchiocchi, and Daniela Anderloni. 2016. Family financial fragility: An Empirical Analysis. *Social Science Electronic Publishing* 50: 33–40.
- Wang, Yanan, Zhuohong Tan, and Lekai Zheng. 2020. Research on the Impact of Digital Inclusive Finance on Social Security. *Quantitative Economy and Technical Economy Research* 37: 92–112.
- Wen, Congle. 2020. *A Study on the Impact of Financial Asset Investment on Household Financial Vulnerability*. Hangzhou: Zhejiang University of Finance and Economics.
- Xie, Fuhui, Yan Shen, Haoxing Zhang, and Guo Feng. 2018. Can digital finance boost entrepreneurship?—Evidence from China. *Economics Quarterly* 18: 1557–80.
- Xie, Mian-bi. 2018. The Influence Factors of Household debt to Income ratio: Evidence from micro survey data. *China's Economic Problems*, 62–72. [\[CrossRef\]](#)
- Xu, Ziyao, Lisha Zhang, and Yizhi Liu. 2020. Does Digital financial inclusion enhance regional innovation capacity. *Science of Finance and Economics* 12: 17–28.
- Yi, Zeng, and Chen Wang. 2012. Analysis on the cost change trend of elderly family care needs in the first half of 21st century. *Economic Research* 12: 134–49.
- Yin, Zhichao, and Donghao Zhang. 2020. Financial Inclusion, Household Poverty and Vulnerability. *Economics Quarterly* 20: 153–72.
- Yue, Wei, Xiong Wang, and Qiang Zhang. 2021. Health risk, medical insurance and household financial vulnerability. *China Industrial Economy* 10: 175–192. [\[CrossRef\]](#)
- Yusof, Selamah Abdullah. 2018. Ethnic disparity in financial fragility in Malaysia. *International Journal of Social Economics* 46: 67–70.
- Yusof, Selamah Abdullah, Rohaiza Abd Rokis, and Wan Jamaliah Wan Jusoh. 2015. Financial fragility of urban families in Malaysia. *Jurnal Ekonomi Malaysia* 49: 15–24. [\[CrossRef\]](#)
- Zhang, Haiyang, and Xiao Han. 2021. Research on the Effect of Digital Finance on Poverty Reduction -- Based on the perspective of Poverty Vulnerability. *Financial Review* 13: 57–77.
- Zhang, Ji, Mengdi Yu, and Yang Cao. 2022. Financial risk assessment of middle-aged and elderly households under Dynamic health impact. *Finance and Economics Research* 60: 153–68.
- Zhang, Ji, Xiao Shi, and Yang Cao. 2020a. Financial Literacy and Household Financial Vulnerability in China. *Journal of Social Sciences Jilin University* 48: 140–150.
- Zhang, Longyao, and Zhaohui Xing. 2021. Research on the Distribution dynamics, Regional Differences and Convergence of Digital Inclusion Finance development in rural China. *Quantitative and Technical Economic Research* 11: 23–42.
- Zhang, Ning, and Ping Zheng. 2013. Research on the Impact of Inclusive Finance on the effectiveness of Household Financial Asset Allocation: Based on the comparison between Traditional and Digital inclusive finance. *Macroeconomic Research* 25: 26–41.
- Zhang, Xun, Tong Yang, Chen Wang, and Guanghua Wan. 2020b. Digital finance Development and Consumer Consumption Growth: Theory and Practice in China. *Managing the World* 36: 48–63.
- Zhao, Lijuan, Lu Zhao, and Xianchao Kang. 2021a. The Impact of financial borrowing on the poverty vulnerability of rural households: A discussion on the mediating effect of agricultural production investment. *Wuhan Finance* 7: 54–61.
- Zhao, Qing, Yuan Guo, and Gangwei Yao. 2021b. Analysis of Household financial Vulnerability: Empirical Evidence based on quantile regression Design. *Western Finance* 8: 68–77.
- Zhong, Kai, Peng Liang, Xiuli Wang, and Wen Peng. 2022. Can digital financial inclusion help curb the shift from real economy to virtual economy?—Based on the analysis of financial asset allocation of real enterprises. *International Finance Research* 12: 13–21.
- Zhou, Li. 2022. Population aging, Life insurance Holdings and Household Asset allocation Efficiency. *Discussion on Modern Economy*, 35–46. [\[CrossRef\]](#)
- Zhou, Li, and Yanyu Chen. 2022. Digital inclusive finance and Urban-Rural income Gap: Theoretical mechanism, empirical evidence and policy Choice. *World Economic Research* 60: 117–134+137.
- Zhou, Xiaochuan. 2013. Follow the Mass Line of the Party to Promote Inclusive financial development. *China Finance* 18: 9–12.
- Zhou, Zhuping, and Haibin Liu. 2016. The Influence of Population Aging on Labor Force Participation Rate. *Population Research* 40: 58–70.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.