How Does the Ageing Population Affect China's Household Savings Rate? Empirical Study Based on China's Micro Household Data

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Abstract

The impact of the ageing population on China's economy and society is multifaceted, with the impact on household savings rates being particularly important. This study investigates the influence of population ageing on household savings rates, utilizing data obtained from the China Household Finance Survey (CHFS) spanning the period from 2015 to 2019. The study found that ageing has a significant negative effect on household savings rates. This finding suggests that there is a significant life-cycle effect on changes in household savings rates in China, which is not conducive to the formation of a second demographic dividend. From the perspective of mediating variables, population ageing growth reduces household income, thereby further decreasing the household savings rate, with income reduction being the main factor causing the decline in the household savings rate. Additionally, it has been found that the impact of population ageing on the household savings rate exhibits significant heterogeneity between urban and rural areas. The increasing proportion of the elderly population in rural areas has a stronger negative effect on the household savings rate.

Keywords: Savings Rate, Ageing, CHFS

1. Introduction

A consistently growing labour force and declining dependency ratio have been important drivers of China's rapid economic growth since the reform and opening up. This economic growth, which is brought about by socio-demographic changes, is known as the demographic dividend (Yang and Cai, 2016). However, in recent years, China has witnessed a rapid trend of population ageing. By 2021, China's population totalled 1.412 billion, with 14.2% of the total population aged 65 and over. The rapid growth of the elderly population has also brought about a rapid increase in the population dependency ratio, which was 8.3% in 1990 and was 20.8% by the year 2021. In addition, the total working age population peaked in 2013. With the demographic shift, the demographic dividend is becoming less of a driver for the economy. Yang (2018) measured the contribution of the demographic dividend to economic growth from 1990 to 2013, showing that the contribution averaged above 20% before 2001 and began to decline gradually after 2001, with the contribution falling to negative values in 2011. However, in contrast, some developed East Asian countries have not experienced economic problems at the end of the demographic dividend period but have achieved high quality growth through a second demographic dividend period (Mason & Kinugasa, 2008). The second demographic dividend demonstrates that the reduction in household size due to increased life expectancy and lower fertility creates an incentive for older people to save for emergencies. This saving incentive can contribute to capital deepening and national economic growth (Lee & Mason, 2011).

High levels of investment have played a crucial role in driving China's previous period of rapid economic growth, with such investment being primarily fuelled by elevated levels of savings (Hu & Xu, 2014). The shift in the age structure of the population is an important factor influencing household savings. Therefore, the mechanism and empirical study of the impact of ageing on household savings rates are of great practical importance for China's economic growth.

This study adopts a micro-level household decision-making perspective and utilizes the CHFS data from 2015 to 2019, comprising three rounds of nationwide micro-level household surveys. It empirically investigates the impact of population ageing on household savings rates. The utilization of high-quality household survey data allows the model to closely capture real-world scenarios, enabling a better exploration of causal mechanisms and heterogeneity effects.

2. Literature Review

The family is the most basic organisational structure in socio-economic activity. The original theory of asset portfolios did not involve intertemporal choices and the investor's objective was to maximise the utility of wealth at the end of the period. In practice, however, decisions in household finance tend to be longer term. The earliest theory to introduce the age factor into the consumption function was the life cycle theory. Traditional life-cycle theory suggests that consumers smooth out their income and consumption in order to maximise utility over their lifetime (Modigliani & Brumberg, 1954). Marginal savings rates are higher in middle age and lower in both youth and old age. Older people experience an increase in daily living

expenses, health care, and other costs as the proportion of older people increases due to the lack of labour income. In other words, ageing reduces the household savings rate (Yuan & Yu, 2014). Fukuda and Okumura (2021) employed a panel data analysis at the county level in Japan, revealing that from the mid-1990s onward, the ageing population has exerted a detrimental influence on the savings rate, following a decline in the working-age population. Given the cultural similarities between China and Japan, as well as the rapid ageing process currently occurring in China, the experience of Japan holds significant implications for China. Ji and Che (2019) conducted a study using data from OECD countries as a sample and found a negative relationship between the old-age dependency ratio and the savings rate. In addition, many other scholars have reached this conclusion (Leff, 1969; Horioka, 2010; Wang, 2017; Zhao et al., 2017; Ji & Che, 2019; Cao et al., 2023).

Traditional life-cycle theory suggests an inverted U-shaped relationship between household savings rates and age. However, some studies have shown that older people still have higher savings rates, a phenomenon known as the "elderly savings puzzle" (Tao et al., 2019). There are several complex motivations behind the saving behaviour of older people in China. Firstly, ageing creates a savings incentive effect through the prevention motive. According to the data published by the China Health Care Commission, the average life expectancy of Chinese residents in 2021 was 78.2 years, which is higher than the global average of 72.27 years. Uncertainty about the age of survival can lead to residents' inability to make optimal decisions about their old age (Yao et al., 2018). As a result, rational individuals make the decision to increase their savings rate in order to secure more funding for survival. In addition, the health of older people deteriorates as they age. This situation creates uncertainty in health care expenditures, and to cope with this uncertainty, rational individuals tend to generate savings based on precautionary motives (Chang & Jiang, 2021). In terms of empirical results, Liu et al. (2021) conducted an empirical study using panel data for 31 provinces in China from 1990-2018. The results indicate that the positive effect of the old age dependency ratio on residents' savings rate is reinforced with economic development; i.e., ageing promotes higher savings rate. Many scholarly studies have reached similar conclusions (Wang, 2020; Chang & Jiang, 2021). The above analysis indicates that there are no firm conclusions on the impact of ageing on household savings rates, either in terms of theoretical mechanisms or empirical evidence, and empirical studies based on micro household data in China lack systematic research.

3. Variable Description and Model Settings

3.1 Variable Description

High-quality micro-level household financial data is crucial for characterizing household behaviour. The data used in this paper are mainly from CHFS for three years, 2015, 2017, and 2019. The data covers 29 provinces and 343 districts and counties, with a sample of 37,289, 40,011, and 34,643 households respectively, making it nationally and provincially representative. The CHFS statistics on household assets are complete and very specific in their information, making them suitable for the empirical research in this thesis.

To mitigate the impact of outliers and missing values on empirical research, in this paper, the

full sample is treated as follows: Firstly, income outliers are eliminated by excluding households with income in the top 2% and bottom 2% brackets. Secondly, households with missing data are excluded from the sample. Thirdly, the sample of households with savings rate less than -200% is removed from this paper. After processing, this paper obtains balanced panel data from three years: 2015, 2017, and 2019, from a total of 20,052 households.

3.1.1 Dependent Variable

Household savings rate is the dependent variable. Referring to the study by Li and Xu (2020), the household savings rate is computed by dividing the discrepancy between total household income and household consumption by the total household income. Household consumption expenditures include other consumption expenditures such as food consumption and health care expenditures.

The first savings rate is calculated as: Savings rate = (total household income - household consumption expenditure) / total household income.

3.1.2 Core Independent Variables

In this paper, two indicators are selected to measure the degree of ageing. The first indicator is the proportion of individuals aged 65 and above within the total household population. The second indicator is the age of the household head. Generally, the household head assumes the role of decision-maker in family matters and wields substantial influence over household investment decisions.

3.1.3 Control Variables

Control variables include household net worth, head of household's gender, head of household's educational level, head of household's health status, head of household's marital status, per capita GDP of the province where the household is located, and the proportion of the financial industry in the GDP of the province where the household is located.

The variable definitions and descriptive statistics of variables are shown in Table 1 and Table 2, respectively. According to Table 2, the mean of China's household savings rate is 0.08, with a minimum of -2 and a maximum of 0.98. In terms of ageing indicators, the mean proportion of elderly people in Chinese households is 0.26, and the mean age of household heads is 56.83. in addition, in terms of household net worth, the average net worth of Chinese households is RMB 926,000.

Table 1. Variable Description

Variables	Code	Measurement Method
Dependent Variables		
Savings Rate	SR	The ratio of net income to total household income
Independent Variables		
Ageing	PEP	Percentage of the elderly over 65 in the total family population
	AGE	Age of household head
Control Variables		
Family Net Worth	FNW	Total household assets minus total household liabilities
Gender	HHG	Males are assigned a value of 1, while females are assigned a value of 0
Education Level	EDU	Educational level of head of household
Health Status	HS	Assigning values based on health status
Marital Status	MS	Married is assigned a value of 1, unmarried is assigned a value of 0
Per Capita GDP	GPC	GDP per capita
Proportion of Financial Industry in GDP	FSG	Proportion of Financial Industry in GDP

Table 2. Descriptive statistics of variables

Variables	Obs	Mean	SD	Min	Max
SR	20052	0.08	0.62	-2	0.98
PEP	20052	0.26	0.37	0	1
AGE	20052	56.83	13.11	4	100
EDU	20052	2.95	1.02	1	5
HHG	20052	0.78	0.41	0	1
MS	20052	0.88	0.33	0	1
HS	20052	0.43	0.50	0	1
FNW	20052	92.60	539.46	-186.10	73393.80
FSG	20052	8.00	3.37	3.82	18.50
GPC	20052	6.70	3.14	2.62	16.42

3.3 Model Settings

This paper empirically examines the impact of ageing on household savings rates using the head of household's age and the proportion of elderly population within the household as proxy indicators of ageing at the micro-level of families. In this paper, the model is set up as follows with reference to Li and Xu (2020) and Yu et al. (2021).

$$SR_{it} = \alpha_{it} + \beta \times PEP_{it} + \delta \times X_{it} + H_{it} + Y_t + \varepsilon_{it}$$

$$SR_{it} = \alpha_{it} + \beta \times AGE_{it} + \delta \times X_{it} + H_{it} + Y_t + \varepsilon_{it}$$

where X denotes control variables, both at the household level and at the district level. H denotes individual-fixed effects for each household and Y denotes year-fixed effects.

4. Benchmark Regression Results

This paper selects a fixed-effects model based on the results of the LM test and the Hausman test and uses clustering robust standard errors for empirical testing. The FEM can address the problem of omitted variables that do not change over time for individual-fixed effects but do change with individuals. In addition, this paper also introduces time-fixed effects and constructs a two-way fixed-effects model. The introduction of time-fixed effects addresses the issue of omitted variables that do not change with individuals but do change over time. The regression results are presented in Table 3, indicating that an increase in the proportion of elderly people and household head age have significant negative effects on the household savings rate.

Table 3. Ageing Population and Household Savings Rate, 2015-2019

	(1)	(2)	(3)	(4)	(5)	(6)
	FE	FE	Two-way FE	Two-way FE	Two-way FE	Two-way FE
PEP	-0.149***		-0.145***		-0.134***	
	(-5.00)		(-4.78)		(-4.41)	
AGE		-0.002**		-0.003***		-0.002*
		(-2.57)		(-3.04)		(-1.70)
EDU	0.015	0.007			0.018*	0.013
	(1.45)	(0.68)			(1.70)	(1.22)
HHG	0.028*	0.032*			0.009	0.011
	(1.70)	(1.90)			(0.54)	(0.66)
MS	0.067**	0.065**			0.068**	0.067**
	(2.47)	(2.38)			(2.50)	(2.47)
HS	0.060***	0.058***			0.051***	0.050***
	(5.07)	(4.89)			(4.39)	(4.28)
FNW	0.000	0.000			0.000	0.000
	(1.17)	(1.21)			(1.32)	(1.34)
FSG	-0.014**	-0.016***			-0.011*	-0.012*
	(-2.40)	(-2.75)			(-1.70)	(-1.80)
GPC	-0.013***	-0.014***			-0.003	-0.004
	(-3.89)	(-4.37)			(-0.78)	(-0.93)
2017.time			0.076***	0.073***	0.082***	0.078***
			(7.89)	(7.56)	(7.44)	(7.08)
2019.time			-0.055***	-0.061***	-0.041***	-0.048***
			(-5.21)	(-5.74)	(-2.92)	(-3.34)
N	20052	20052	20052	20052	20052	20052

Note: Cluster robust standard errors are given in parentheses. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

5. Mechanism Analysis

From a life-cycle perspective, older people earn substantially less compared to middle-aged people and must maintain necessary living and health care expenses. That is, as the elderly population increases, society's marginal propensity to save begins to decline. Based on the above analysis, this paper argues that ageing brings with it a reduction in income and hence in the household savings rate. To investigate this mediating effect, the paper introduces a

variable representing household income (HI) and constructs the following mediating effect model:

$$SR_{it} = \alpha_{it} + \beta \times PEP_{it} + \delta \times X_{it} + H_{it} + Y_t + \varepsilon_{it}$$

$$HI_{it} = \alpha_{it} + \delta \times PEP_{it} + \delta \times X_{it} + H_{it} + Y_t + \varepsilon_{it}$$

$$SR_{it} = \alpha_{it} + \gamma \times HI_{it} + \beta' \times PEP_{it} + \delta \times X_{it} + H_{it} + Y_t + \varepsilon_{it}$$

The test results are shown in Table 4. In this paper, the Sobel-Goodman test was used to test for mediation effects and household-fixed effects and time-fixed effects were added to the regression model. The Sgmediation2 command provides three types of tests, namely Sobel, Aroian, and Goodman tests, during the examination process. The results of all three tests show significance at the 1% level, indicating that there is a significant mediation effect. The empirical results above indicate that population ageing leads to a decrease in household income, which further reduces the household savings rate. Additionally, the decrease in income is identified as the main factor causing the decline in the household savings rate.

Table 4. Sobel-Goodman Mediation Test Result

	SR1
Sobel	-0.168***
	(-13.542)
Goodman-1	-0.168***
	(-13.540)
Goodman-2	-0.168***
	(-13.544)
Mediation Effect	-0.168***
	(-13.542)
Direct Effect	0.035
	(1.315)
Total Effect	-0.134***
	(-4.660)
Proportion of total effect that is mediated	1.258
N	20052

6. Robustness Check

6.1 Replace the Dependent Variable

For the robustness of the empirical findings, this paper will use the second approach to calculate the household saving rate. As medical expenditure is related to the health status of household members, it is sudden and contingent in nature. Education expenditures are related to the age of children within the household and are stage specific. In order to avoid the disturbance caused by these expenditures on household consumption, and with reference to the studies by Li and Huang (2015) and Zhou et al. (2021), this paper subtracts medical and

education expenditure from total household expenditure and performs the calculation of savings rate.

The second savings rate is calculated as: Savings rate = (total household income - household consumption expenditure + health expenditure + education expenditure) / total household income.

The regression results are shown in Table 5. The regression results show that the regression results in Table 5 are not significantly different from those in Table 3 and both are significant at the 1% level, which confirms the robustness of the core finding of this paper that ageing reduces the household savings rate.

Table 5. The Estimation Results for Replacing the Dependent Variable

	(1)	(2)	(3)	(4)	(5)	(6)
	FE	FE	Two-way FE	Two-way FE	Two-way FE	Two-way FE
PEP	-0.136***		-0.145***		-0.139***	
	(-4.63)		(-4.85)		(-4.65)	
AGE		-0.002**		-0.002**		-0.002**
		(-2.12)		(-2.49)		(-1.97)
EDU	0.002	-0.004			0.003	-0.001
	(0.19)	(-0.36)			(0.34)	(-0.15)
HHG	0.031*	0.035**			0.011	0.014
	(1.94)	(2.14)			(0.70)	(0.89)
MS	0.046*	0.046*			0.050*	0.050*
	(1.74)	(1.72)			(1.87)	(1.85)
HS	0.029***	0.028**			0.021*	0.019*
	(2.62)	(2.47)			(1.88)	(1.74)
FNW	0.000	0.000			0.000	0.000
	(1.05)	(1.08)			(1.25)	(1.27)
FSG	0.003	0.001			-0.005	-0.006
	(0.59)	(0.20)			(-0.88)	(-0.93)
GPC	-0.007**	-0.009***			-0.004	-0.005
	(-2.37)	(-2.87)			(-1.07)	(-1.19)
2017.time			0.111***	0.107***	0.115***	0.111***
			(12.08)	(11.63)	(11.04)	(10.63)
2019.time			-0.012	-0.019**	-0.001	-0.008
			(-1.18)	(-1.96)	(-0.09)	(-0.62)
N	21300	21300	21300	21300	21300	21300

Note: Cluster robust standard errors are given in parentheses. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively, the same applies to the following.

6.2 Replace the Independent Variable

In developed countries, the age of 65 and above is generally used as a criterion for classifying older people, but in China, the latest age at which people generally retire is 60 years old. Therefore, this study introduces a variable (PEP60) to measure population ageing, defined as the proportion of individuals aged 60 and above in the household. The results of the robust regressions using PEP60 as the independent variable are shown in Table 6. The regression results demonstrate a significant negative impact of population ageing on household savings.

Moreover, compared to the regression results in Table 3, the absolute values of the coefficient estimates in Table 5 are larger.

Table 6. The Estimation Results for Replacing the Independent Variable

	(1)	(2)	(3)
	FE	Two-way FE	Two-way FE
PEP60	-0.236***	-0.243***	-0.233***
	(-8.02)	(-8.18)	(-7.80)
EDU	0.011		0.013
	(1.09)		(1.29)
HHG	0.029*		0.009
	(1.72)		(0.56)
MS	0.062**		0.063**
	(2.30)		(2.35)
HS	0.059***		0.051***
	(5.02)		(4.33)
FNW	0.000		0.000
	(1.15)		(1.31)
FSG	-0.011*		-0.011*
	(-1.95)		(-1.67)
GPC	-0.011***		-0.003
	(-3.40)		(-0.75)
2017.time		0.083***	0.089***
		(8.60)	(8.06)
2019.time		-0.045***	-0.031**
		(-4.26)	(-2.22)
N	20052	20052	20052

7. Heterogeneity Analysis

7.1 Heterogeneity Test in Urban and Rural Areas

Over the years, China has developed a distinct dualistic pattern between urban and rural areas. Urban regions have experienced vigorous growth due to their advanced economic infrastructure, abundant employment opportunities, and sophisticated industrial structure, attracting a large concentration of talent and capital. In contrast, rural areas face constraints such as inadequate infrastructure, limited employment opportunities, and reliance on traditional agricultural economies, resulting in relatively slower economic development. The long-standing urban-rural dualism in China has led to significant disparities in economic development between urban and rural regions, and these disparities may result in heterogeneity in the impact of ageing on household savings rates. This paper introduces a binary choice variable (RURAL) to represent urban or rural areas, where the values of 1 and 0 respectively indicate rural households and urban households.

The regression results are presented in Table 7. The coefficients of the interaction terms in the first and second columns are significantly negative at the 1% level. This suggests that in rural areas, an increase in the proportion of elderly population has a stronger negative impact on household savings rates. The interaction terms in the third and fourth columns are negative,

but not statistically significant.

Table 7. Heterogeneity Analysis Based on Urban and Rural Areas, 2015-2019.

	(1)	(2)	(3)	(4)
	Two-way FE	Two-way FE	Two-way FE	Two-way FE
PEP	-0.091***	-0.079**		
	(-2.70)	(-2.33)		
AGE			-0.002*	-0.001
			(-1.77)	(-0.63)
RURAL	0.016	0.013	0.112	0.113
	(0.25)	(0.20)	(1.02)	(1.03)
RURAL#PEP	-0.152**	-0.157**		
	(-2.43)	(-2.50)		
RURAL#AGE			-0.002	-0.002
			(-1.35)	(-1.39)
EDU		0.017*		0.014
		(1.68)		(1.31)
HHG		0.008		0.010
		(0.51)		(0.58)
MS		0.067**		0.067**
		(2.49)		(2.47)
HS		0.052***		0.050***
		(4.42)		(4.27)
FNW		0.000		0.000
		(1.33)		(1.34)
FSG		-0.012*		-0.012*
		(-1.84)		(-1.84)
GPC		-0.004		-0.004
		(-0.88)		(-0.97)
2017.time	0.076***	0.082***	0.073***	0.078***
	(7.88)	(7.51)	(7.53)	(7.08)
2019.time	-0.055***	-0.040***	-0.061***	-0.048***
	(-5.20)	(-2.82)	(-5.77)	(-3.36)
N	20052	20052	20052	20052

7.2 Heterogeneity Test in Health

Physical health is an important factor influencing older people's expenditure in later life, and older people who are healthy can reduce their expenditure on medical care and health products, thereby reducing their marginal propensity to consume. Thus, the factor of whether older people are physically healthy leading to ageing demonstrates heterogeneity in its effect of household savings rates.

The regression results are shown in Table 8. The coefficient of the interaction term in the first column is significantly positive at the 1% level, indicating that household heads having good health can mitigate the negative impact of ageing on household savings rates. The coefficient of the interaction term in the second column is positive, but not statistically significant.

Table 8. Heterogeneity Analysis Based on Head of Household Health, 2015-2019.

	(1)	(2)
	Two-way FE	Two-way FE
AGE	-0.003***	-0.002*
	(-3.17)	(-1.90)
HS#AGE	0.001***	0.001
	(4.53)	(0.95)
HS		0.005
		(0.10)
EDU		0.014
		(1.25)
HHG		0.011
		(0.67)
MS		0.066**
		(2.43)
FNW		0.000
		(1.35)
FSG		-0.012*
		(-1.80)
GPC		-0.004
		(-0.92)
2017.time	0.071***	0.078***
	(7.34)	(7.10)
2019.time	-0.060***	-0.048***
	(-5.72)	(-3.32)
N	20052	20052

8. Conclusions

China has entered a phase of rapid ageing, and the ageing of the population will have an impact on different aspects of the economy, which may expose the Chinese economy to a range of problems. This paper selects three years of household microdata from 2015, 2017, and 2019 to empirically test the impact of ageing on household savings rates. The findings are as follows: First, this paper empirically tests the FE model and the Two-way FE model to conclude that ageing has a significant negative effect on the household savings rate. This suggests a significant life-cycle effect on changes in household savings rates in China but not a significant precautionary saving effect. Secondly, from the perspective of mediating variables, population ageing growth reduces household income, thereby further lowering the household savings rate, and the decrease in income serves as the primary cause for the decline in the household savings rate. Finally, considering the urban-rural heterogeneity, in rural areas, the increasing proportion of elderly population has a stronger negative impact on the household savings rate.

Based on the findings of the aforementioned research, this paper suggests that in the formulation and implementation of future population and economic policies in China, a closer alignment with relevant theories and empirical results is essential. The increasing ageing population will lead to a decline in China's household savings rate, and, according to the analysis of influencing mechanisms, this is attributed to the ageing population reducing

household income, thereby further diminishing the household savings rate.

Therefore, the government should undertake measures to alleviate the impact of ageing on household income. One proposed measure involves providing free or low-cost training courses to assist the elderly in acquiring new skills. This initiative aims to enhance their skills and knowledge, thereby improving their employability and income levels. Additionally, the government may consider offering additional financial support for pensions based on the financial circumstances of the elderly, helping them meet their essential living needs. Furthermore, it is recommended that the government establish a more robust private pension savings system. There could even be consideration for the creation of a dedicated pension savings protection plan to incentivize residents to actively participate in private pension savings.

From the results of heterogeneity analysis, it is evident that the increasing proportion of the elderly population in rural areas has a more pronounced negative impact on household savings rates. Given the urban-rural disparities, the government may consider establishing a differentiated pension system to better meet the retirement needs of rural elderly individuals and encourage more proactive pension savings in rural households. Additionally, by implementing measures such as guiding industrial transfer and supporting rural entrepreneurship, the government can strive to expand employment opportunities in rural areas, elevate farmers' income levels, and consequently enhance the likelihood of household savings.

Authors contributions

Yuan and Puah were responsible for the data collection and arrangement of the relevant literature, data analysis, and article writing. Yau commented on the study choice and wrote the original draft of the article. All authors have read and agreed to the published version of the manuscript.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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