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Research Article

Complexity between Aging and the Structure of Financial Market: Empirical Evidence from Microdata

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By empirically testing the scale and structure hypotheses of aging's impacts on the financial market using Tobit, FRM, and Heckman selection models, this paper proves that the number and proportion of elderly family members change the structure of families' financial assets, though without significant effects on their overall size. Specifically, aging increases the share of cash and deposits in families' total financial assets and decreases both the quantity and percentage of investment in risky assets. One more family member aged sixty and over, the risky assets decline by 5, 500RMB and its share decreases by 8.8 percent. A Heckman two-step model verifies the robustness of our results. The heterogeneity analysis reveals that aging plays different roles in different types of financial assets.

1. Introduction

Aging means the rise in the proportion of the elderly population aged 60 or 65 and above. Although virtually every country has been experiencing growth in the number and proportion of the elderly in their population [1], aging's effects on the financial market remains a complex question to be answered. Aging may influence the financial market by affecting the scale or structure of microagents' financial asset allocation [2–4]. Therefore, two kinds of hypotheses could be proposed concerning the scale and structure of the impacts of demographic change on the financial market. Specifically, the scale effect means that aging may cause households to increase or decrease the overall scale of financial assets. The structural effect arises from the assumption that aging may impact the proportion of families' investment in different types of financial assets. Whether and how population aging affects the financial market awaits in-depth analysis.

To date, few empirical research has been conducted concerning the impact of aging on the scale and structure of financial market from the perspective of microagents. Existing studies on the effects of aging on the financial market have been conducted mainly from a macro-perspective using theoretical methods [5]. Limited research on the relationship between aging and financial assets allocation has been conducted using microdatasets [3, 6], based on which our scale hypothesis and structural hypothesis are proposed. However, existing microlevel studies mainly focus on the relationship between the age of individuals and their financial knowledge, cognitive ability, and risk preference [7,8], but not directly explore the influence of aging on financial asset allocation.

Our study fills this gap by contributing to the understanding of aging's effects on the financial market. Considering that China has the largest elderly population and a sharp rise in the proportion of the elderly, this paper uses a microdataset from the China Family Panel Studies (CFPS) to investigate the impact of population aging on the size and structure of financial assets [9]. Since the financial market is determined by an aggregation of individual or household financial decisions, it is anticipated that the results of this microdata analysis will help to explain and predict how aging will affect the demand side of the general financial market.

This research contributes to the literature by validating the structural hypothesis regarding the effect of demographic transition on the financial market, yet the scale hypothesis was rejected. Specifically, aging has no significant impacts on the volume of families' financial investment, but it changes the structure of the financial investment by making families allocate more investment to lower-risk financial assets and crowds out financial investment with higher risk. If at least one family member is aged sixty or more, the proportion of cash and deposits in total financial assets increase by an average 20.3 percent compared to a family with no members over age 60, indicating that aging encourages families to allocate 20 percent more of their financial assets to cash and deposits. At the same time, having an additional family member age sixty or more reduces the percentage of risky assets by 8.8 percent.

Following this introduction, the paper is organized as follows. Section 2 reviews the relevant literature and proposes hypotheses. Section 3 introduces the data, variables, and methods used in our research and analyzes empirical results. Conclusion is given in Section 4.

2. Literature Review and Hypotheses Development

The impacts on the economy of aging have been emphasized in the context of changes in the structure of global population. However, relevant studies are primarily concerned with how aging affects the labor market, including its impacts on the labor supply, labor participation, and labor quality (human capital), with much less research conducted from the perspective of capital market. The existing literature concerning aging's impact on the capital market mainly focuses on variation in the savings rate during the process of societal aging. This stream of research consists of the demographic-dividend theory based on the life-cycle consumption hypothesis [4, 10, 11] and a second demographic-dividend theory based on the precautious savings hypothesis [12, 13], both of which analyze the impact of aging on savings preferences and the corresponding consequences for economic growth. But less attention has been paid to the effects of aging on the financial market.

Research concerning the relationship between aging and the financial market has been conducted mainly from a macro perspective [5]. Imam [14] illustrates that aging tends to have considerable effects on the stability of the financial sector through the channel in which older households are exposed to new types of risks. However, other studies identify positive impacts of aging on investment in risky assets. For example, Alda [15] finds that aging can contribute to both contractions and expansions in the stock market under different circumstances. An important channel through which aging expands the financial market is the investment in pension funds, which could be increased with the rising doubt about the pension systems. Yoon and Rhee [16] support Alda's findings, demonstrating that the Japanese financial market has been more positively affected by population aging than those of Germany and the US.

Limited research on the relationship between demographic change and financial market has been conducted using microdatasets [7], based on which our scale hypothesis and structural hypothesis could be proposed. From the perspective of life-long financial assets allocation, it is argued that, because of rising life expectancy and the inadequacy of public pensions, people make deliberate plans for investment in financial assets before retirement [2]. Based on this theory, families with more elderly members tend to have fewer financial assets after retirement. However, empirical findings on this hypothesis are inconsistent. Love et al. [17]; which first proposes the scale hypothesis argues that although the retirement of family members leads to a reduction in household assets, the magnitude and speed of the reduction are lower than those theoretically anticipated. Poterba [18] further points out that in the US, uninsured late-life expenditures induced by health shocks explain the decline in household financial assets after retirement. Furthermore, using data from an Australian family panel survey, Spicer et al. [19] reveal that asset prices and investment preferences are important factors affecting the volume of postretirement assets, and the average financial assets of Australian families after retirement, including both defensive and growth financial assets, tend to rise between 2002 and 2006 and decline between 2006 and 2010. Based on this line of studies, we propose the hypothesis of the structural effects of aging on financial markets.

Scale Hypothesis: Elderly members in the family have significant effects on its scale of financial assets.

Another line of literature mainly explores the relationship between aging and investment in financial assets from the perspective of risk and liquidity preferences, and analyzes the heterogeneity of financial allocation in families with different age structures. This theory also examines evidence on the relationship between age and cognitive ability from the perspective of medical and social psychology research [8]. Lusardi et al. [20] are the first to propose the structural hypothesis. They state that the ability of individuals to understand new and complex financial investment tools tend to decline with aging. Consequently, the demand for nontraditional financial products will decrease, with a significant impact on the general structure of the financial market. An earlier study on US households argues that the percentage of individuals in families aged sixty-five and above is negatively related to their investment in stocks [21]. Furthermore, Fagereng et al. [6]; demonstrate a rebalancing of Norwegian households' portfolio composition away from stocks when they approach retirement. By contrast, using Japanese data, Iwaisako et al. [22] reveal that the quantity of risky assets held by a household increases with the age of the household head increases. Elderly households (as proxied by the age of the household head) tend to invest more in stocks and less in savings [3]. Based on this stream of research, we propose the hypothesis of the structural effects of aging on financial markets.

Structure Hypothesis: Elderly members in the family have significant effects on its structure of financial assets.

3. Data and Empirical Methodology

3.1. Data. The data in this study come from CFPS, a national longitudinal survey. By collecting data at three levels (individual, family, community), this survey provides nationwide social and economic information for academic research and public policy analysis. CFPS focuses on both the economic and non-economic well-being of Chinese citizens, covering substantive areas such as economic activities, physical and mental health, family structure and relationships, population migration, and educational attainment. The CFPS target sample consists of 16,000 households in twenty-five provinces/municipalities/autonomous regions in China, representing 95 percent of the Chinese population [23]. CFPS uses probability-proportional-to-size sampling (PPS) with implicit stratification and is highly representative of the Chinese population.

So far, five CFPS waves have been conducted: 2010, 2012, 2014, 2016 and 2018. They all provide information on families' financial assets, but in an inconsistent manner. Information concerning families' financial assets in the five waves is illustrated in Table 1. The 2012 wave has the most detailed information on financial assets while those in 2010, 2016, and 2018 have relatively little information on them. Therefore, a two-year panel dataset was generated combining the 2012 and 2014 waves to retain relatively detailed information on financial assets. The panel dataset contains information on families' financial investment in cash, deposits, stocks, funds, government bonds, derivatives, and debt owed to family members in the broader sense.

3.2. Variables and Descriptive Statistics. To examine the scale hypothesis, this paper uses the total amount of all financial assets (*finance_asset*) as the dependent variable, in which "total" equals to the sum of cash, deposits, stocks, funds, bonds, derivatives, and debt. To test the structure hypothesis, a regression analysis is conducted for different kinds of financial assets and their percentages in total financial assets. The first is the amount of a family's total cash and deposits (*cash_asset*), which is important in China because cash and deposits account for more than 88 percent of the financial assets held by Chinese families (self-calculation using CFPS 2012 and 2014). The second is the amount of a family's total stocks, funds, government bonds, and derivatives (*risk_asset*). Compared with cash and deposits, these financial assets have a higher risk level and are thus regarded as risky assets. Analyzing the impact of aging on risky assets can indicate its impact on the general financial market, particularly when China's economy enters the era of financialization. To further investigate whether aging pushes people to low-risk savings (cash and deposit) or high-risk investment (risky assets), we construct two more dependent variables, the proportion of low-risk financial assets and that of risky assets (*prop_cash* and *prop_riskasset*). Furthermore, to investigate the impacts of aging on families' financial asset allocation in greater detail, we use investment in cash and deposits, stocks, funds, government bonds, and derivatives as dependent variables.

To evaluate the impacts of elderly family members, the explanatory variables are the percentage of family members aged sixty and above (*percentage_60*), the number of family members aged sixty and above (*number_60*), and whether any family members are age sixty and above (*whether_60*). In China, life expectancy is longer than before, and retirement is later, so age sixty-five is generally considered the threshold of the elderlyage. Therefore, using this standard, we constructed *percentage_65*, *number_65,* and *whether_65* as explanatory variables to test the robustness of our analytical results.

Figure 1 shows the descriptive statistical result, demonstrating the correlation matrix of key dependent and explanatory variables. It is shown that the correlation coefficients between the size of financial assets and explanatory variables, including percentage_60, number_60, whether_60, percentage_65, number_65 and whether_65, are negative. However, they are statistically insignificant and not robust. In addition, these estimates are very small, indicating almost negligible economic significance. These preliminary descriptive results seem not to support the scale hypothesis concerning the impacts of aging on financial markets. Furthermore, Figure 1 also illustrates that the correlation coefficients between the proportion of cash assets and aging parameters are all positive, whereas the relationships between the share of risk assets and aging are negative. Besides, these coefficients are all very significant and robust. This seems to lend credence to the structural hypothesis regarding the impact of aging on financial markets. We test these results more rigorously in the empirical research section.

The control variables include independent variables for raising children and family characteristics. We use three control variables for raising children, corresponding to different explained variables: the percentage of family members aged fourteen and below, the number of family members aged fourteen and below, and whether any family members are aged fourteen and below. Variables of family characteristics that may affect families' investment in financial assets are considered, including whether the family lives in urban areas, the number of family members who are employed, the number of family members aged sixty and over who have a pension, the number of family members aged fifty-nine and below who have a pension, total expenses, other assets, net income, savings rate, homeownership (house or apartment), whether family members have education in economics or management, and personal characteristics of the family head. The CFPS does not identify the family head, so this paper defines the family member with the highest income as the family head to capture his/her characteristics, including the education background, age, and employment status. Furthermore, year dummy variables and province dummy variables are also included in the regressions. The definitions and descriptive statistics of the variables are in Table 2.

3.3. Empirical Methodology. Because some families in the sample do not have certain types of financial asset

Table 1: Information on families' financial assets in different waves of CFPS.

Financial assets	2010 wave	2012 wave	2014 wave	2016 wave	2018 wave
Cash and deposits	Yes	Yes	Yes	Yes	Yes
Stocks	Yes	Yes	No	No	No
Funds	Yes	Yes	No	No	No
Government bonds	Yes	Yes	No	No	No
Corporate bonds	No	No	No	No	No
Bonds (including government bonds and corporate bonds)	Yes	No	No	No	No
Derivatives	No	Yes	No	No	No
Debts owed to the family	Yes	Yes	Yes	Yes	Yes
Other financial assets	No	Yes	No	No	No
The sum of stocks, funds, government bonds, derivatives	No	Yes	Yes	No	No
The sum of stocks, funds, government bonds, trusts, foreign exchange assets	No	No	No	Yes	Yes
Financial assets (including cash, deposits, stocks, funds, government bonds, derivatives, and debts owed to the family)	No	Yes	Yes	No	No
Financial assets (including cash, deposits, stocks, funds, and debts owed to the family)	Yes	Yes	No	No	No

Note. Yes means that the information is available or can be calculated from the original datasets. No means the information is unavailable.

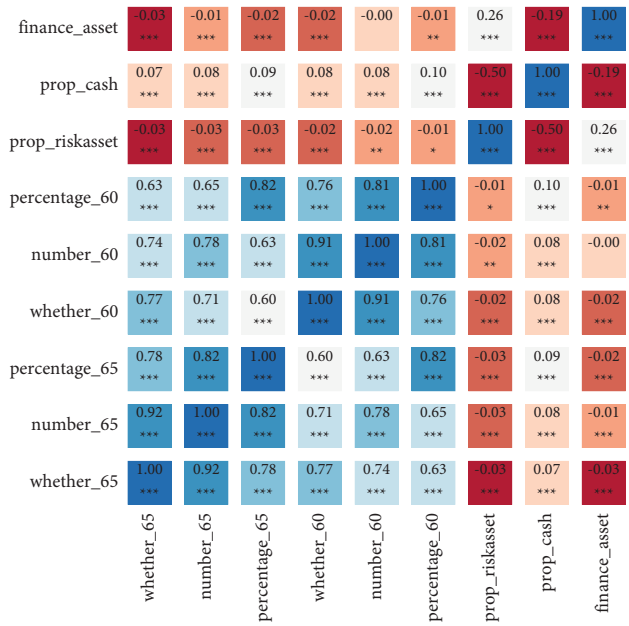

Figure 1: Correlation matrix of key dependent and explanatory variables. Note: ***, **, and * denote the significance of the correlation at the 1%, 5%, and 10% level.

investment, the distributions of the explained variables demonstrate the censored characteristics rather than normal distributions. For this type of explained variables, the Ordinary Least Squares (OLS) model could not be used for regression, because it does not meet the normality assumption of the OLS model. Tobit model is developed to deal with the zero-inflated data [24]. Besides, the Heckman selection model can also be applied for this kind of explained variables. We use the Heckman model to test the robustness of the analytical results, which are basically consistent with the conclusions obtained from the Tobit model, proving the suitability of using the Tobit model. Specifically, the following panel Tobit model is applied to the regressions of censored dependent variables in this paper, including *finance_asset*, *cash_asset*, *risk_asset*, *stock*, *fund*, *govbond*, and *derivatives*.

$$Asset_{it} = \alpha Elde\ r_{it} + \mathbf{X_{it}}\boldsymbol{\beta} + \nu_i + \eta_t + \epsilon_{it}, \tag{1}$$

$$Asset_{it} = \begin{cases} Asset_{it}^{*}, & if\ Asset_{it}^{*} > 0, \\ 0, & if\ Asset_{it}^{*} \le 0, \end{cases} \tag{2}$$

where the subscripts i and t are the indices for families and years. *Asset* represents the observed amounts of financial assets and it could stand for different assets in different regressions, for example, total financial assets, cash assets, risk assets, etc. $Asset_{it}^{*}$ denotes the underlying financial assets investment, where $Asset_{it}^{*}$ could be observed as $Asset_{it}$ only

Table 2: Summary statistics.

Variables	Definition	Mean	Std. dev.	Min.	Max.
Dependent variables					
finance_asset	Total financial assets (RMB)	34,627.420	103,415.400	0	4,240,000
cash_asset	Cash and deposits (RMB)	27,130.860	74,352.080	0	2,000,000
prop_cash	The proportion of cash and deposits in total financial assets	0.881	0.271	0	1
risk_asset	Total risk assets (RMB)	3,360.524	12,616.110	0	3,000,000
prop_riskasset	The proportion of total risk assets in total financial assets	0.024	0.121	0	1
whether_riskasset	Whether investing in risk assets (yes = 1, no = 0)	0.045	0.208	0	1
Stock	Stocks (RMB)	1,354.294	17,095.010	0	1,000,000
prop_stock	The proportion of stocks in total financial assets	0.010	0.074	0	1
Fund	Funds (RMB)	662.792	7,020.862	0	200,000
prop_fund	The proportion of funds in total financial assets	0.007	0.064	0	1
Govbond	Government bonds (RMB)	96.910	3,196.017	0	200,000
prop_govbond	The proportion of government bonds in total financial assets	0.001	0.012	0	0.5561
Derivatives	Derivatives (RMB)	265.831	7,413.188	0	500,000
prop_derivatives	The proportion of derivatives in total financial assets	0.001	0.021	0	1
Explanatory variables					
percentage_60	The percentage of family members age 60 years and older (%)	21.618	32.964	0	100
number_60	The number of family members age 60 years and older	0.634	0.820	0	4
whether_60	Whether there are family members age 60 years and older (yes = 1, no = 0)	0.427	0.495	0	1
percentage_65	The percentage of family members age 65 years and older (%)	14.644	28.649	0	100
number_65	The number of family members age 65 years and older	0.414	0.692	0	4
whether_65	Whether there are family members age 65 years and older (yes = 1, no = 0)	0.306	0.461	0	1
Control variables of raising children					
percentage_14	The percentage of family members age 14 years and younger (%)	14.086	17.062	0	100
number_14	The number of family members age 14 years and younger	0.667	0.877	0	7
whether_14	Whether there are family members age 14 years and younger (yes = 1, no = 0)	0.465	0.499	0	1
Control variables of family characteristics					
Urban	Whether the family is in urban areas (yes = 1, no = 0)	0.485	0.500	0	1
number_work	Number of family members having job	1.533	1.198	0	9
number_insurance_60	Number of family members age 60 years and older having pension	0.615	1.010	0	8
number_insurance_59	Number of family members age 59 years and younger having pension	0.505	0.791	0	6
Expense	Total expenses in last year (RMB)	42,664.990	33,661.290	5,800	127,800
other_asset	Assets excluding financial assets and housing assets	29,801.880	43717.400	0	156,230
Netincome	Net income in previous year (RMB)	37,794.010	31,514.740	2,000	114,400
saving_rate	Savings rate in previous year (%)	−171.395	658.152	−4,113.333	92.641
whether_house	Home ownership (yes = 1, no = 0)	0.887	0.317	0	1
whether_eco	Whether family members have education in economics or management (yes = 1, no = 0)	0.044	0.205	0	1
edu_head	Family head's education level	2.846	1.367	1	8
age_head	Family head's age	45.190	16.690	0	102
whether_work_head	Whether the family head has a job	0.683	0.465	0	1
number_hospital	Number of family members in hospital during in the previous year	0.241	0.492	0	4
Year dummy variables and provincial dummy variables (omitted)					

Note. Statistics of stocks, funds, government bonds, and derivatives are calculated using the 2012 wave datasets. Statistics of other variables are calculated using the datasets from the 2012 and 2014 waves.

when families choose to invest. *El de r* captures the effects of aging and could be the percentage of the family members aged 60/65 and above in the total family members, the number of members aged 60/65 and above, and whether there are family members aged 60/65 and above (yes = 1, no = 0). $\mathbf{X_{it}}$ is a set of control variables. ν_i and η_t are family and year fixed effects. υ_i is i.i.d., $N(0, \sigma_\upsilon^2)$. ϵ_{it} is i.i.d., $N(0, \sigma_\epsilon^2)$ independent of υ_i.

The variables for cash and deposits, total risky assets, stocks, funds, bonds, and financial derivatives account for a certain proportion of household financial assets. Consequently, *prop_cash*, *prop_riskasset*, *prop_stock*, *prop_fund*, *prop_govbond*, and *prop_derivatives* are bounded variables. For the proportional dependent variables, the traditional Logit and Probit models are not satisfactory because the assumptions on the distributions are too strict. Moreover, a

Tobit model is applied only to the unilaterally limited response variables. Therefore, this paper uses the panel Fractional Response Model (FRM) to estimate the proportional dependent variables. The log-likelihood function for the panel FRM is

$$lnL = \sum_{i=1}^{N} y_{it} ln\left[G\left(\mathbf{X_{it}^{'}}\boldsymbol{\beta}\right)\right] + (1 - y_{it}) ln\left[1 - G\left(\mathbf{X_{it}^{'}}\boldsymbol{\beta}\right)\right], \quad (3)$$

where N is the sample size, y_{it} is the dependent variable, $\mathbf{X_{it}}$ are the covariates, lnL is maximized, and $G(\cdot)$ can be the probit or logit model. This study uses both the probit and logit model to estimate β and obtains very similar results. Results presented in the following sections use the probit model.

In addition, a panel Heckman two-stage model is also applied to analyze the dual-stage characteristic of families' decisions on risky investment. Specifically, this approach divides these decisions into two stages with different mechanisms, helping us to see how aging separately influences whether to invest in risky assets and the amount of investment in risky assets. Risky assets are modelled as

$$risk\_asset_{it} = \alpha Elde\ r_{it} + \mathbf{X_{it}}\boldsymbol{\beta} + \nu_{1i} + \eta_t + \epsilon_{1t}, \quad (4)$$

where $\mathbf{X_{it}}$ are the covariates, ν_{1i} is the panel-level random effect and ϵ_{1t} is the observational-level error. The selection process for the outcome is modelled by

$$s_{it} = 1\left(\mathbf{Z_{it}}\boldsymbol{\gamma} + \nu_{2i} + \epsilon_{2t} > 0\right), \quad (5)$$

where $s_{it} = 1$ if we observe investment in risky assets and 0 otherwise, $\mathbf{Z_{it}}$ are the covariates modeling selection, ν_{2i} is the panel-level random effect for selection, and ϵ_{2t} is the observation-level selection error.

The random effects ν_{1i} and ν_{2i} are bivariate normal with mean 0 and variance:

$$\begin{pmatrix} \sigma_{1\nu}^2 & \rho_v \sigma_{1\nu}\sigma_{2\nu} \\ \rho_v \sigma_{1\nu}\sigma_{2\nu} & \sigma_{2\nu}^2 \end{pmatrix}. \quad (6)$$

The observation-level errors ϵ_{1it} and ϵ_{2it} are bivariate normal, with mean 0 and variance:

$$\begin{bmatrix} \sigma_1^2 & \rho\sigma_1 \\ \rho\sigma_1 & 1 \end{bmatrix}. \quad (7)$$

These observation-level errors are independent of the random effects. Maximum likelihood is applied to model both the selection and outcome equations and account for the panel structure of the data. The random-effects estimator in this paper is referred in Rabe-Hesketh et al. [25].

3.4. Empirical Results

3.4.1. The Effects of Aging on the Scale of Families' Investment in Financial Assets. Table 3 shows the regression results in which investment in household financial assets is the explained variable. The findings demonstrate no significant influence of aging on investment in financial assets with a sixty-year-old as the standard for being elderly. The estimates of the proportion of family members aged sixty-five and over and the dummy variable for whether any family members are age sixty-five and over are negative. This may be caused by the increased medical costs and expenses for elderly care demanded by family members aged sixty-five or above. However, because the significance levels of the two coefficients are not high and the estimate of *percentage_65* is not significant, the negative effects of aging on the scale of financial assets are not robust. Therefore, it is noted that aging has no significant impacts on the scale of Chinese families' financial investment. Figure 2 illustrates the point estimates and their 95% confidence intervals of the impact of aging coefficients, including *number_60*, *whether_60*, *number_65*, *whether_65*, on the scale of financial assets derived from Table 3. It is demonstrated that almost all the confidence intervals cover zero, clearly indicating that the impact of aging on the scale of financial assets is not significant and consequently fails to support the scale hypothesis.

The regression results of control variables demonstrate that the relationship between raising children and investment in financial assets is insignificant. It is likely that two mutually counteractive mechanisms are involved. First, the more children a family has, the greater their living and education expenses, and the fewer assets are available for investment. The second mechanism is that in China, having more children could motivate families to invest in more financial assets to prepare for their future education and even marriage expenses. These two mechanisms cancel each other out, resulting in the insignificance of raising children.

Concerning the estimated results of other control variables, the higher the household income, the larger the financial assets. In addition, because family expenditure is positively related to income, expenditure is positively correlated with the size of financial assets. The number of people with pensions under the age of sixty basically reflects those engaged in formal employment in the Chinese context, which is positively related to family wealth and asset levels. Therefore, its estimated coefficient is significantly positive. The variable for whether family members have education in economics or management is estimated to be positive, indicating that financial knowledge can significantly raise the scale of families' financial investment. The estimated coefficient of the savings rate is significantly negative, revealing that the lower the assets level is, the higher is the household's precautionary savings preference. The estimates for homeownership are significantly negative, meaning that investment in financial assets is crowded out by investment in real estate.

In addition, the older the family head, the bigger the scale of investment in financial assets, which have two causes. First, financial assets accumulate over time and rise with the age of the family head. Second, the family head may plan to leave bequests to their offspring and consequently invest more in financial assets. The square of the family head's age is estimated to be negative, which is consistent with the existing literature mentioned above, e.g., Chu et al. [26]. This implies that families tend to have more financial assets as the

Table 3: Results on the scale of families' financial assets.

	Panel tobit model					
	finance_asset	*finance_asset*	*finance_asset*	*finance_asset*	*finance_asset*	*finance_asset*
percentage_60	−11.596					
	(28.046)					
number_60		−593.820				
		(1024.077)				
whether_60			−2.4e + 03			
			(1660.747)			
percentage_65				−60.781**		
				(29.702)		
number_65					−1.8e + 03	
					(1148.225)	
whether_65						−5.1e + 03***
						(1721.270)
percentage_14	−5.168			−14.753		
	(50.111)			(49.890)		
number_14		−1.1e + 03			−1.1e + 03	
		(999.451)			(996.742)	
whether_14			−792.781			−913.429
			(1587.205)			(1584.070)
Urban	7580.110***	7498.478***	7522.106***	7518.699***	7455.556***	7469.767***
	(1668.507)	(1669.718)	(1668.577)	(1668.175)	(1669.504)	(1667.612)
number_work	−2.1e + 03**	−2.0e + 03**	−2.0e + 03**	−2.1e + 03**	−1.9e + 03**	−1.9e + 03**
	(906.497)	(911.854)	(910.395)	(905.904)	(911.362)	(909.412)
number_insurance60	1.7e + 04**	1.7e + 04**	1.8e + 04**	1.7e + 04**	1.7e + 04**	1.7e + 04**
	(7841.616)	(7844.190)	(7836.124)	(7807.729)	(7807.246)	(7804.061)
number_insurance59	388.008	330.873	279.179	283.511	271.559	215.925
	(1399.745)	(1399.253)	(1397.144)	(1394.492)	(1395.357)	(1393.858)
Expense	0.235***	0.238***	0.235***	0.232***	0.237***	0.234***
	(0.032)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
other_asset	0.026***	0.026***	0.026***	0.026***	0.026***	0.026***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Netincome	0.269***	0.272***	0.272***	0.270***	0.272***	0.273***
	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)
saving_rate	−13.886***	−14.071***	−14.023***	−13.758***	−14.049***	−14.025***
	(4.789)	(4.790)	(4.789)	(4.787)	(4.789)	(4.786)
whether_house	−9.9e + 03***	−9.7e + 03***	−9.7e + 03***	−1.0e + 04***	−9.8e + 03***	−9.8e + 03***
	(2591.061)	(2590.986)	(2591.155)	(2592.749)	(2590.470)	(2589.512)
whether_eco	1.2e + 04***	1.2e + 04***	1.2e + 04***	1.2e + 04***	1.2e + 04***	1.2e + 04***
	(3233.845)	(3234.581)	(3233.825)	(3232.801)	(3234.108)	(3231.935)
edu_head	726.671***	712.393***	714.808***	734.189***	719.246***	724.554***
	(188.693)	(188.740)	(188.557)	(188.659)	(188.763)	(188.409)
age_head	271.340***	260.490***	283.958***	314.599***	280.356***	308.116***
	(66.273)	(62.854)	(61.839)	(63.911)	(61.265)	(60.619)
age_head^2	−6.314**	−5.766**	−4.926*	−4.002	−4.931*	−3.410
	(2.936)	(2.744)	(2.725)	(3.097)	(2.830)	(2.792)
whether_work_head	3305.923	3068.770	3056.100	3003.662	2845.745	2714.473
	(2111.144)	(2121.067)	(2116.663)	(2113.512)	(2123.004)	(2118.588)
year dummies	Not significant	Not significant	Not significant	Not significant	Not significant	Not significant
Province dummies	Significant	Significant	Significant	Significant	Significant	Significant
Constant variable	−7.0e + 03	−6.4e + 03	−6.9e + 03	−7.6e + 03	−6.9e + 03	−7.1e + 03
	(9404.598)	(9395.652)	(9385.161)	(9401.505)	(9388.974)	(9378.067)
Observations	16,953	16,953	16,953	16,953	16,953	16,953

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level. Figures in parenthesis are standard errors.

head of the household ages, but after a certain age, the family's financial assets declines. Furthermore, the result demonstrates that after the age of the household head is controlled for, the family's age structure still has significant effects on their financial assets, which is omitted in the existing literature and is one contribution of this research.

3.4.2. The Effects of Aging on the Structure of Families' Investment in Financial Assets. Cash and deposits, as the assets with the least risk, are the main financial investment made by Chinese families. Therefore, this paper divides families' financial assets into two types: cash and deposits (low-risk assets) and risky assets. Table 4 presents the regression

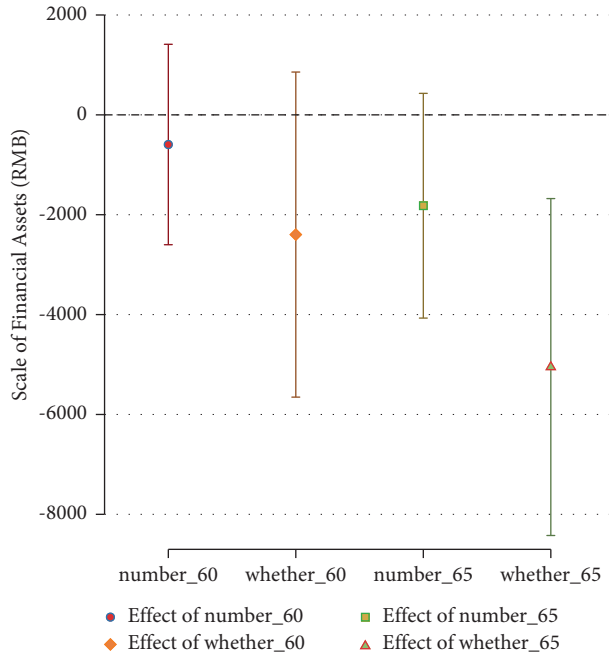

Figure 2: Point estimates and 95% confidence intervals of aging's effects on the scale of financial assets.

results with the quantity of cash and deposits as the dependent variable. The estimates of the variables are not robustly significant. The estimates of the control variables with cash and deposits as the dependent variable are basically consistent with those with the family total financial assets as the dependent variable. However, it is noteworthy that the estimated coefficients on whether family members have education in economics or management are different in Tables 3 and 4. The effect of *whether_eco* on cash and deposits is only about half of that on total financial assets. This demonstrates that financial knowledge on cash and deposits has less impact than other types of financial assets, which is further analyzed in the following sections.

Table 5 presents the basic regression results when cash and deposits as a proportion of total financial assets is considered as dependent variable. The explanatory variables are the same as those in Tables 2 and 4. The estimated results of the coefficients on aging are significantly positive. Moreover, except for *whether_65*, all of them are significant at the level of 1 percent, verifying their robustness. The estimate of *whether_60* demonstrates that, holding other conditions constant, if at least one family member is aged sixty or older, the proportion of cash and deposits in total financial assets rise by 20.3 percent on average, indicating that aging encourages families to allocate one-fifth or more of their financial assets to cash and deposits. Meanwhile, with an increase in the number and proportion of elderly family members, the ratio of cash and deposits in total financial assets rises correspondingly. We conclude that although aging does not significantly affect the quantity of the total financial assets, it can change the structure of families' financial assets and encourage families to allocate more financial assets to traditional and low-risk assets.

Table 6 presents the basic regression results when the quantity of risky assets is the dependent variable. The explanatory variables are the same as above. Our results demonstrate that regardless of whether we consider old age to commence at sixty or sixty-five and the explanatory variable (the quantity, proportion, or dummy variable of elderly family members), the estimated coefficients on aging are significantly negative, indicating that aging reduces families' investment in risky assets. On average, holding other conditions constant, one additional family member aged sixty and over induces a decline of more than RMB 5,000 in risky assets investment. This quantity is very impressive, which means that one more family member aged sixty and over, the share of risky assets in total financial assets declines by 8.8 percent. We conclude due to aging, Chinese families are more risk averse toward financial investment and thus decrease their quantity of risky assets.

The estimated coefficients of control variables for family characteristics are consistent with our theoretical expectations. For example, the estimated coefficient of the urban dummy variable is high and significant, indicating that on average urban families tend to invest more than their rural counterparts in risky assets. The estimates of net income are significantly positive, indicating that the quantity of risky assets rises with income increasing. The estimated coefficient of the dummy variable of homeownership (yes = 1, no = 0) is significantly negative, which demonstrates that investment in real estate is an alternative to investment in risky assets and may crowd it out. The variable for whether family members have education in economics or management (yes = 1, no = 0) is significantly positive, and its magnitude is higher than that in Tables 3 and 4, revealing that financial knowledge influences families' investment in risky assets much more than in total financial assets and traditional assets. The explanation

Table 4: Results on the scale of families' cash and deposits.

	Panel tobit model					
	cash_asset	*cash_asset*	*cash_asset*	*cash_asset*	*cash_asset*	*cash_asset*
percentage_60	−8.843					
	(20.623)					
number_60		−209.518				
		(753.121)				
whether_60			$-2.1e+03^{*}$			
			(1221.135)			
percentage_65				−37.784*		
				(21.842)		
number_65					$-1.2e+03$	
					(844.446)	
whether_65						$-3.8e+03^{***}$
						(1265.688)
percentage_14	24.472			18.963		
	(36.847)			(36.688)		
number_14		−277.843			−278.252	
		(735.011)			(733.040)	
whether_14			535.674			429.880
			(1167.060)			(1164.802)
Urban	6727.287***	6700.667***	6680.588***	6690.267***	6667.023***	6648.358***
	(1226.852)	(1227.935)	(1226.892)	(1226.732)	(1227.813)	(1226.232)
number_work	$-1.2e+03^{*}$	$-1.2e+03^{*}$	$-1.1e+03^{*}$	$-1.2e+03^{*}$	$-1.1e+03^{*}$	$-1.1e+03$
	(666.546)	(670.591)	(669.406)	(666.178)	(670.249)	(668.711)
number_insurance60	$1.3e+04^{**}$	$1.3e+04^{**}$	$1.4e+04^{**}$	$1.3e+04^{**}$	$1.3e+04^{**}$	$1.3e+04^{**}$
	(5765.934)	(5768.733)	(5761.841)	(5741.597)	(5741.729)	(5738.501)
number_insurance59	−6.629	1.521	−105.403	−63.416	−58.681	−132.488
	(1029.232)	(1029.031)	(1027.309)	(1025.473)	(1026.195)	(1024.935)
Expense	0.139***	0.142***	0.139***	0.137***	0.141***	0.138***
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
other_asset	0.015***	0.015***	0.015***	0.015***	0.015***	0.015***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Netincome	0.189***	0.189***	0.190***	0.189***	0.190***	0.191***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
saving_rate	−9.510***	−9.625***	−9.583***	−9.431***	−9.610***	−9.578***
	(3.521)	(3.523)	(3.521)	(3.521)	(3.522)	(3.519)
whether_house	$-6.1e+03^{***}$	$-6.0e+03^{***}$	$-6.0e+03^{***}$	$-6.3e+03^{***}$	$-6.1e+03^{***}$	$-6.1e+03^{***}$
	(1905.205)	(1905.450)	(1905.256)	(1906.639)	(1905.125)	(1904.126)
whether_eco	6876.607***	6780.071***	6898.553***	6852.801***	6751.788***	6896.429***
	(2377.844)	(2378.759)	(2377.807)	(2377.316)	(2378.479)	(2376.514)
edu_head	633.531***	622.425***	624.111***	638.263***	627.076***	632.196***
	(138.746)	(138.802)	(138.644)	(138.735)	(138.823)	(138.542)
age_head	204.524***	188.636***	219.273***	229.504***	205.753***	233.329***
	(48.730)	(46.224)	(45.470)	(46.998)	(45.056)	(44.575)
age_head^2	−5.317**	−5.093**	−4.061**	−4.130*	−4.496**	−3.073
	(2.158)	(2.017)	(2.003)	(2.276)	(2.080)	(2.052)
whether_work_head	1995.203	1928.531	1856.693	1814.993	1755.067	1627.787
	(1552.323)	(1559.864)	(1556.366)	(1554.221)	(1561.333)	(1557.845)
Year dummies	Not significant	Not significant	Not significant	Not significant	Not significant	Not significant
Province dummies	Significant	Significant	Significant	Significant	Significant	Significant
Constant variable	8445.853	9217.683	8508.217	8114.578	8821.616	8397.758
	(6915.194)	(6909.701)	(6900.836)	(6913.618)	(6904.989)	(6895.903)
Observations	16,989	16,989	16,989	16,989	16,989	16,989

Note: ***, **, and * denote significance at the 1%, 5% and 10% level. Figures in parenthesis are standard errors.

may be that, in comparison with cash and deposits, investment in risky assets requires that the family has a higher capacity for collecting, collating, and analyzing financial information and financial investment skills. Therefore, if at least one family member has education in economics or management, investment in risky assets is enhanced.

The family head's education level, age, and employment status are all positively related to demand for risky assets. Our result on the relationship between the family head's age and total risky assets differ from those in Lu and Turvey [27]; because in analyzing the age characteristics of families, they control for the dummy variables of the family head age

Table 5: Results on the proportion of families' cash and deposits.

	Panel FRM model					
	prop_cash	*prop_cash*	*prop_cash*	*prop_cash*	*prop_cash*	*prop_cash*
percentage_60	0.004*** (0.001)					
number_60		0.143*** (0.038)				
whether_60			0.203*** (0.058)			
percentage_65				0.004*** (0.001)		
number_65					0.127*** (0.043)	
whether_65						0.154** (0.062)
Year dummies	Not significant	Not significant	Not significant	Not significant	Not significant	Not significant
Province dummies	Significant	Significant	Significant	Significant	Significant	Significant
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant variable	1.159*** (0.240)	1.126*** (0.241)	1.116*** (0.239)	1.167*** (0.235)	1.118*** (0.236)	1.119*** (0.236)
Observations	16,891	16,891	16,891	16,891	16,891	16,891

Note. Yes means the corresponding variables are controlled. In Table 5, the control variables for raising children are *percentage_14*, *number_14*, and *whether_14*. Control variables for family characteristics are the same as those in Table 1, and regression results are similar to those in Table 4. ***, **, and * denote significance at the 1%, 5%, and 10% level. Figures in parenthesis are standard errors.

groups and draw the conclusion that the older the family head, the lower the investment in risky assets. After controlling the variables for family age, we find that the family head's age does not necessarily decrease investment in risky assets. On the contrary, the results demonstrate that the demand for risky assets increases with the family head's age up to a certain point. One possible explanation is that an older family head may have more experience in allocating financial assets or a better understanding of the financial market, which could favor investment in risky assets. Therefore, the real factors that contribute to a decline in risky assets are the number and proportion of elderly family members, rather than the age of the family head.

The dependent variable in Table 6 denotes the total family risky assets. To further test the robustness of the conclusion, this paper applies the FRM model and uses the proportion of risky assets in total financial assets as the dependent variable. As shown in Table 7, regardless of whether we consider the elderly to be sixty-year-olds or sixty-five-year-olds and the explanatory variable (the quantity, proportion, or the dummy variable for elderly family members), aging significantly decreases Chinese families' demand for risky assets. Hence, risky assets as a proportion of total financial assets declines with aging, which verifies the robustness of our earlier conclusions.

Figure 3 illustrates the point estimates and their 95% confidence intervals of the impact of the aging coefficients, including *number_60*, *whether_60*, *number_65*, and *whether_65*, on the structure of financial assets derived from Tables 5 and 7. Aging positively affects the proportion of cash and savings assets, and their confidence intervals are well above zero. In contrast, aging coefficients are all significantly negative on the proportion of risky assets, and their confidence intervals are all below zero. These results clearly confirm the structural hypothesis of aging's impact on financial markets.

This analysis demonstrates that the impact of aging on risky assets is significantly negative. This paper uses the Heckman two-stage model to further analyze how aging influences decisions on risky assets. The dummy variable for whether to invest in risky assets (*whether_riskasset*) is the explanatory variable in the first-stage regression. Moreover, the instrumental variable in the first-stage regression is the number of family members in the hospital during the previous year. The regression results with sixty-year-olds are presented here, but those with sixty-five-year-olds are similar. The results are shown in Table 8 with the percentage of family members aged sixty and over, the number of family members aged sixty and over, and whether any family members are aged sixty or more as the explanatory variables.

The results in Table 8 demonstrate that regardless of the independent variables, the estimated coefficients of aging variables in Heckman two-stage regressions are significantly negative. It further proves the robustness of our earlier regression conclusions, indicating that aging has significantly negative effects on families' demand for risky assets. Furthermore, it also shows that aging not only reduces the likelihood that families will invest in risky assets but also decreases the amount of the investment.

3.4.3. Heterogeneity Analysis. To investigate the impacts of aging on different types of financial assets, we use the data in the cross-sectional 2012 wave of the CFPS to further analyze its effects on both the amount and proportion of cash and deposits, stocks, funds, government bonds, and derivatives. The regression results are presented in Tables 9 and 10. Table 9 demonstrates the results using the Tobit model, with

Table 6: Results on the scale of families' risky assets investment.

	Panel tobit model					
	risk_asset	*risk_asset*	*risk_asset*	*risk_asset*	*risk_asset*	*risk_asset*
percentage_60	−125.399*					
	(65.211)					
number_60		−5.5e + 03**				
		(2390.664)				
whether_60			−1.3e + 04***			
			(3941.788)			
percentage_65				−408.361***		
				(79.207)		
number_65					−1.4e + 04***	
					(2865.312)	
whether_65						−2.3e + 04***
						(4329.459)
percentage_14	86.278			75.490		
	(111.965)			(110.889)		
number_14		−1.1e + 03			−1.1e + 03	
		(2680.503)			(2666.730)	
whether_14			1232.873			1011.837
			(3455.357)			(3441.807)
Urban	4.1e + 04***	4.0e + 04***	4.1e + 04***	4.1e + 04***	4.0e + 04***	4.0e + 04***
	(5176.390)	(5175.477)	(5171.890)	(5160.710)	(5171.343)	(5168.487)
number_work	−8.4e + 03***	−8.0e + 03***	−8.0e + 03***	−8.5e + 03***	−7.9e + 03***	−8.1e + 03***
	(2223.932)	(2226.709)	(2226.068)	(2219.045)	(2228.457)	(2230.626)
number_insurance60	88.254	1011.602	1695.025	842.085	1235.045	982.011
	(4186.460)	(4233.328)	(4179.310)	(4076.299)	(4091.423)	(4069.637)
number_insurance59	9346.983***	9308.909***	9268.014***	9062.460***	9182.908***	9258.430***
	(1869.758)	(1861.220)	(1855.636)	(1846.837)	(1850.140)	(1848.411)
Expense	0.285***	0.293***	0.289***	0.273***	0.292***	0.286***
	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)
other_asset	0.015***	0.016***	0.016***	0.015***	0.016***	0.016***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Netincome	0.300***	0.307***	0.306***	0.304***	0.307***	0.305***
	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)
saving_rate	2.111	1.422	1.269	0.997	1.089	0.873
	(14.991)	(14.906)	(14.931)	(14.935)	(14.881)	(14.913)
whether_house	−1.3e + 04***	−1.2e + 04***	−1.2e + 04***	−1.3e + 04***	−1.3e + 04***	−1.3e + 04***
	(4788.735)	(4778.888)	(4776.079)	(4782.505)	(4773.038)	(4768.660)
whether_eco	1.4e + 04***	1.4e + 04***	1.4e + 04***	1.4e + 04***	1.4e + 04***	1.4e + 04***
	(4180.030)	(4173.765)	(4173.948)	(4154.698)	(4159.424)	(4163.943)
edu_head	4640.197***	4573.558***	4564.463***	4691.426***	4597.581***	4591.064***
	(490.008)	(488.836)	(488.396)	(491.351)	(489.499)	(489.008)
age_head	919.511***	863.723***	914.920***	1101.185***	982.661***	1002.175***
	(153.421)	(147.721)	(147.308)	(153.569)	(148.669)	(148.576)
age_head^2	−35.457***	−32.710***	−30.599***	−21.107***	−25.181***	−24.968***
	(8.057)	(7.527)	(7.439)	(8.168)	(7.635)	(7.570)
whether_work_head	1.1e + 04**	1.0e + 04**	9900.828**	1.1e + 04**	1.0e + 04**	1.0e + 04**
	(4655.209)	(4663.608)	(4660.531)	(4608.360)	(4632.074)	(4635.340)
Year dummies	Not significant	Not significant	Not significant	Not significant	Not significant	Not significant
Province dummies	Significant	Significant	Significant	Significant	Significant	Significant
Constant variable	−2.6e + 05***	−2.6e + 05***	−2.6e + 05***	−2.7e + 05***	−2.6e + 05***	−2.6e + 05***
	(1.7e + 04)	(1.7e + 04)	(1.7e + 04)	(1.7e + 04)	(1.7e + 04)	(1.7e + 04)
Observations	16,953	16,953	16,953	16,953	16,953	16,953

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level. Figures in parenthesis are standard errors.

the quantity variables as the explanatory variables. Table 10 shows the results of the FRM model, with the proportion of these financial assets as the explanatory variables. The regressions use sixty-year-olds as the standard for the elderly and those with the sixty-five-year-old as the standard have similar results.

The results in Tables 9 and 10 further prove that aging has different impacts on different types of financial assets and thus changes the structure of Chinese families' financial investment. Figure 4 portraits the impact of aging on the proportions of different types of financial assets in greater detail. It is shown that aging's effects on cash assets and

Table 7: Results on the proportion of families' risk assets investment.

	Panel FRM model					
	prop_riskasset	*prop_riskasset*	*prop_riskasset*	*prop_riskasset*	*prop_riskasset*	*prop_riskasset*
percentage_60	−0.003**					
	(0.001)					
number_60		−0.088**				
		(0.043)				
whether_60			−0.174**			
			(0.068)			
percentage_65				−0.005***		
				(0.002)		
number_65					−0.181***	
					(0.055)	
whether_65						−0.272***
						(0.080)
Year dummies	Significant	Significant	Significant	Significant	Significant	Significant
Province dummies	Significant	Significant	Significant	Significant	Significant	Significant
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant variable	−3.688***	−3.656***	−3.655***	−3.769***	−3.727***	−3.715***
	(0.252)	(0.252)	(0.251)	(0.250)	(0.250)	(0.251)
Observations	16,855	16,855	16,855	16,855	16,855	16,855

Note. In this table, the control variables for raising children are *percentage_14*, *number_14*, and *whether_14*. Control variables for family characteristics are the same as those in Table 1, and regression results are similar to those in Table 6. ***, **, and * denote significance at the 1%, 5%, and 10% level. Figures in parenthesis are standard errors.

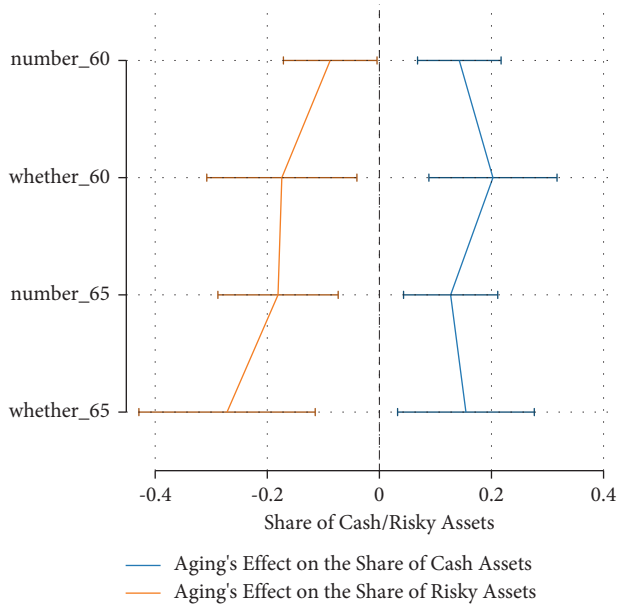

Figure 3: Point estimates and 95% confidence intervals of aging's effects on the share of cash and risky assets.

government bond are significantly positive, while its impacts on stocks, funds and derivatives are negative. This further confirms the structural hypothesis of aging's impacts on financial markets. Aging's effects on cash and deposits and government bond are significantly positive, whereas its impacts on stocks, funds and derivatives are negative. However, the influence on funds and derivatives are not significant. Possible reasons are that as the funds and derivative markets are not mature in China, they are not the main choices for most families. Stocks are the most popular risky assets for Chinese families, and the negative effects of aging may mainly induce decreased demand for stocks. In China, government bonds are less risky than stocks. In view of the increasing population share of the elderly, families tend to be more risk averse, which increases investment in government bonds. This further verifies our conclusions about the impact of aging on risk preferences and the structure of financial investment.

Table 8: Results on families' risky assets investment using Heckman two-stage model.

	Heckman selection model 1 *whether_riskasset*	Heckman selection model 1 *risk_asset*	Heckman selection model 2 *whether_riskasset*	Heckman selection model 2 *risk_asset*	Heckman selection model 3 *whether_riskasset*	Heckman selection model 3 *risk_asset*
percentage_60	−0.002* (0.001)	−164.847* (89.889)				
number_60			−0.091** (0.039)	−7.7e + 03** (3579.818)		
whether_60					−0.199*** (0.063)	−1.6e + 04** (7058.503)
Year dummies	Not significant	Not significant	Not significant	Not significant	Not significant	Not significant
Province dummies	Significant	Significant	Significant	Significant	Significant	Significant
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant variable	−4.394*** (0.234)	−2.1e + 05 (1.3e + 05)	−4.348*** (0.234)	−2.1e + 05 (1.3e + 05)	−4.369*** (0.233)	−2.4e + 05* (1.4e + 05)
Mills Lambda	6.6e + 04* (3.5e + 04)		5.6e + 04* (3.2e + 04)		7.1e + 04* (3.7e + 04)	
Observations	16,953	16,953	16,953	16,953	16,953	16,953

Note. In this table, the control variable for raising children is *percentage_14*. The other control variables for family characteristics are the same as those in Table 1, and regressions results are similar to those in Table 6. ***, **, and * denote significance at the 1%, 5%, and 10% level. Figures in parenthesis are standard errors.

Table 9: Results on the scales of different types of financial assets.

	Tobit model				
	cash_asset	*stock*	*Fund*	*govbond*	*derivatives*
percentage_60	−2.172 (34.207)	−470.966** (203.981)	−41.331 (126.226)	40.307* (26.830)	−424.401** (701.362)
Province dummies	Significant	Significant	Significant	Significant	Significant
Control variables	Yes	Yes	Yes	Yes	Yes
Constant variable	−9.0e + 03 (1.1e + 04)	−5.2e + 05*** (5.4e + 04)	−3.1e + 05*** (3.8e + 04)	−3.1e + 05*** (7.4e + 04)	2.6e + 05 (1.8e + 05)
Observations	8,328	8,328	8,328	8,327	8,334

Note. In this table, the control variable for raising children is *percentage_14*. The other control variables for family characteristics are the same as those in Table 1. ***, **, and * denote significance at the 1%, 5%, and 10% level. Figures in parenthesis are standard errors.

Table 10: Results on the proportions of different types of financial assets.

	FRM model				
	prop_cash	*prop_stock*	*prop_fund*	*prop_govbond*	*prop_derivatives*
percentage_60	0.003*** (0.001)	−0.002* (0.001)	−0.001 (0.002)	0.002* (0.001)	−0.003 (0.002)
Province dummies	Significant	Significant	Significant	Significant	Significant
Control variables	Yes	Yes	Yes	Yes	Yes
Constant variable	2.463*** (0.217)	−4.047*** (0.395)	−4.474*** (0.392)	−5.907*** (0.995)	−2.267*** (0.569)
Observations	8,302	8,302	8,302	8,297	8,302

Note. In this table, the control variable for raising children is *percentage_14*. The other control variables for family characteristics are the same as those in Table 1. ***, **, and * denote significance at the 1%, 5%, and 10% level. Figures in parenthesis are standard errors.

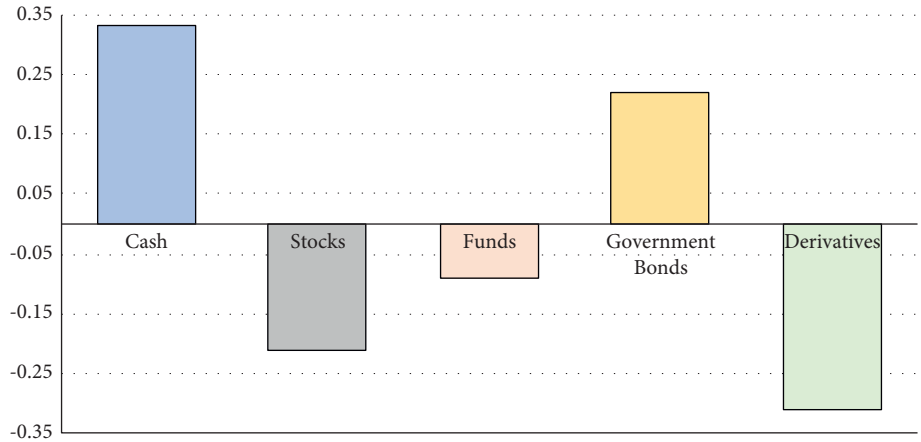

Figure 4: Heterogeneous effects of aging (*percentage_60*) on the share of different types of financial assets (%).

4. Conclusions

This paper empirically investigates the impact of aging on the scale and structure of microfinancial investment using data in the CFPS and analyzes the heterogeneous impacts of aging on different types of financial assets. This study contributes to the understanding of aging's effects on the financial market, which has not been covered by existing literature. First, our analytical results verify the structural hypothesis regarding the impacts of aging on families' financial assets investment, but not the scale hypothesis. Specifically, aging has no significant impact on the amount of financial investment by Chinese families, but it changes the structure of their investment. Aging significantly increases the proportion of cash and deposits in total financial assets, while decreasing investment in risky assets. If at least one family member is aged sixty or more, the proportion of cash and deposits in total financial assets increase an average 20.3 percent compared to a family without members over age 60. In addition, with one more elderly member aged over 60 years old, the share of risky assets in total financial assets declines by 8.8 percent. Second, aging not only has negative effects on the probability of investment in risky assets but also decreases the amount of risky assets in which families invest. Third, aging has different effects on different types of financial assets. It has positive effects on cash, deposits, and government bonds, negative impacts on stocks, and no significant influence on funds and derivatives.

Based on these results, we propose some policy implications concerning the development of financial market in the context of aging. To begin with, assessments of aging's impacts on the capital market and economy should emphasize the impacts on financial assets. Active measures should be taken to promote the development of the financial market with aging. Moreover, aging has significant impacts on the structure of Chinese families' financial investment, proving its effects on the structure of the demand side of financial market from a micro perspective. Therefore, financial institutions in China, such as banks, securities companies, funds companies, and derivatives trading institutions, should take different measures in response to the impacts of aging. Third, considering the risk aversion attitudes toward the investment in risky assets, financial innovations are in need to create financial products and services that are more appropriate for aging Chinese population.

Admittedly, this paper has limitations. First, as the calibers of financial indicators in different waves of CFPS are not completely comparable, the samples that can be fully utilized are limited. We look forward to further verifying the conclusions of this paper when more consistent longitudinal could be available in the future, so as to enhance the robustness of our results. Second, the research results are based on observational data, which inevitably have certain self-selection problems. Although this paper uses the Heckman selection model to solve this problem, the research results would enjoy more support if experimental data could be available. Future research can continue to make marginal contributions in these two directions.

Data Availability

The data that support the findings of this study are available from China Family Panel Studies (CFPS, http://www.isss.pku.edu.cn/cfps/). Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the authors with the permission of CFPS.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of the study.

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References

[1] United Nations, *World Population Ageing 2020*, Department of Economic and Social Affairs, United Nations, New York, 2020.

[2] J. Strough, J. Wilson, and W. Bruine de Bruin, "Aging and financial decision making," in *Psychological Perspectives on Financial Decision Making*, T. Zaleskiewicz and J. Traczyk, Eds., pp. 167–186, Springer, 2020.

[3] S. Brown, D. Gray, M. N. Harris, and C. Spencer, "Household portfolio allocation, uncertainty, and risk," *Journal of Empirical Finance*, vol. 63, pp. 96–117, 2021.

[4] E. Feyen, J. Frost, L. Gambacorta, H. Natarajan, and M. Saal, *Fintech and the Digital Transformation of Financial Services: Implications for Market Structure and Public Policy, BIS Papers*, Bank for International Settlements, number 117, 2021.

[5] D. Andolfatto, A. Berentsen, and F. M. Martin, "Money, banking, and financial markets," *The Review of Economic Studies*, vol. 87, no. 5, pp. 2049–2086, 2020.

[6] A. Fagereng, C. Gottlieb, and L. Guiso, "Asset market participation and portfolio choice over the life-cycle," *The Journal of Finance*, vol. 72, no. 2, pp. 705–750, 2017.

[7] G. Guido, C. Amatulli, and A. Sestino, "Elderly consumers and financial choices: A systematic review," *Journal of Financial Services Marketing*, vol. 25, no. 3-4, pp. 76–85, 2020.

[8] F. Del Missier, P. Hansson, A. M. Parker, W. Bruine de Bruin, and T. Mäntylä, "Decision-making competence in older adults: A rosy view from a longitudinal investigation," *Psychology and Aging*, vol. 35, no. 4, pp. 553–564, 2020.

[9] National Bureau of Statistics of China, "China statistical year Book," 2021, http://www.stats.gov.cn/tjsj/ndsj/ Accessed.

[10] F. Modigliani and R. Brumberg, "Utility analysis and the consumption function: An interpretation of cross-section data," in *Post Keynesian Economics*, K. K. Kurihara, Eds., pp. 388–436, Rutgers University Press, New Brunswick, 1954.

[11] W. Joe, A. Kumar, and S. Rajpal, "Swimming against the tide: economic growth and demographic dividend in India," *Asian Population Studies*, vol. 14, no. 2, pp. 211–227, 2018.

[12] R. Lee and A. Mason, "What is the demographic dividend?" *Finance & Development*, vol. 43, no. 3, pp. 16-17, 2006.

[13] M. Cruz and S. A. Ahmed, "On the impact of demographic change on economic growth and poverty," *World Development*, vol. 105, pp. 95–106, 2018.

[14] P. Imam, "Demographic shift and the financial sector stability: the case of Japan," *Journal of Population Ageing*, vol. 6, no. 4, pp. 269–303, 2013.

[15] M. Alda, "The relationship between pension funds and the stock market: does the aging population of Europe affect it?" *International Review of Financial Analysis*, vol. 49, pp. 83–97, 2017.

[16] D. R. Yoon and D. E. Rhee, "The impact of population aging on financial market structures and policy implications," KIEP Research Paper, World Economy Brief 17-17, Seoul, Korea Institute for International Economic Policy, 2017.

[17] D. A. Love, M. G. Palumbo, and P. A. Smith, "The trajectory of wealth in retirement," *Journal of Public Economics*, vol. 93, no. 1-2, pp. 191–208, 2009.

[18] J. M. Poterba, "Retirement security in an aging population," *The American Economic Review*, vol. 104, no. 5, pp. 1–30, 2014.

[19] A. Spicer, O. Stavrunova, and S. Thorp, "How portfolios evolve after retirement: evidence from Australia," *The Economic Record*, vol. 92, no. 297, pp. 241–267, 2016.

[20] A. Lusardi, O. S. Mitchell, and V. Curto, "Financial literacy and financial sophistication in the older population," *Journal of Pension Economics and Finance*, vol. 13, no. 4, pp. 347–366, 2014.

[21] J. Heaton and D. Lucas, "Portfolio choice in the presence of background risk," *The Economic Journal*, vol. 110, no. 460, pp. 1–26, 2000.

[22] T. Iwaisako, A. Ono, A. Saito, and H. Tokuda, "Impact of population aging on household savings and portfolio choice in Japan," in *Real Estate Markets, Financial Crisis, and Economic Growth: An Integrated Economic Approach Working Paper Series No.61*Institute of Economic Research at Hitotsubashi University, Tokyo, 2016.

[23] Y. Xie, X. Zhang, P. Tu et al., *China Family Panel Studies User's Manual*, 2017, http://www.isss.pku.edu.cn/cfps/wdzx/yhsc/index.htm Accessed, 3rd edition.

[24] T. Chen and G. Tripathi, "A simple consistent test of conditional symmetry in symmetrically trimmed Tobit models," *Journal of Econometrics*, vol. 198, no. 1, pp. 29–40, 2017.

[25] S. Rabe-Hesketh, A. Skrondal, and A. Pickles, *Multilevel Selection Models Using Gllamm. Combined Dutch and German Stata Users Group Meeting Proceedings 2002,* https://ideas.repec.org/p/boc/dsug02/1.html.

[26] Z. Chu, Z. Wang, J. J. Xiao, and W. Zhang, "Financial literacy, portfolio choice and financial well-being," *Social Indicators Research*, vol. 132, no. 2, pp. 799–820, 2017.

[27] Y. Lu and C. G. Turvey, "The influencing factors and urban-rural differences in the behavior of household risky assets holding in China," *Finance & Trade Economics*, vol. 35, no. 9, pp. 72–81, 2014, (in Chinese).