Consumer Financial Knowledge and Retirement Planning Behaviors

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

With the increasingly serious problem of population aging around the world, the issue of consumer retirement planning behaviors has been highlighted in recent years. The purpose of this study is to investigate the effect of consumer financial knowledge on retirement planning behaviors. Utilizing the data from the National Financial Capability Study in 2009, 2012, 2015, and 2018, this study measures consumer retirement planning behavior through the variables of whether consumers have retirement accounts and whether they regularly contribute to their retirement account. To verify the robustness, a series of additional regressions are conducted by replacing the estimation approach and dropping income outliers. The results imply that consumers with a high level of financial knowledge tend to perform desirable retirement behaviors. Based on the results, we recommend that financial education programs should be widely introduced and targeted at those who lack financial knowledge, such as the elderly and the under-educated, to stimulate consumers to improve their retirement planning behaviors.

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1. INTRODUCTION

These days, the aging population has become an international problem. Over the past few decades, life expectancy has risen sharply by about 2 to 3 years for each decade and this number shows a continuing upward trend in the future [1]. In light of these rising figures, an effective retirement plan plays a substantial role in relieving the social pressure caused by the aging of the population [2]. Based on desirable retirement plans, individuals can make overall financial arrangements, such as managing their income and asset, to achieve their retirement goals. Furthermore, evidence has shown that a desirable retirement planning behavior helps to promote wealth accumulation, improve financial satisfaction, and realize the optimization of the life cycle [3]. To guide consumers in retirement planning effectively, governments of most countries around the world have also established sound retirement systems.

According to the development history of retirement security systems in various countries, retirement system has undergone tremendous change with the development of new products and financial services. One of the most significant changes is that consumers are increasingly required to take on responsibility for managing their retirement accounts, implying that decision-making on saving, investing, and wealth accumulation has been shifted to workers and retirees [4-6]. In the 1980s, the retirement pensions of the elderly in the United States mainly relied on a defined-benefit (DB) pension plan funded by social security and employers, which is based on the implementation and management of the government. According to the DB plan, participants only need to decide when to apply for benefits but do not have the responsibilities of paying attention to details of the plan, including what assets are invested and the information of risk-reward ratio. The power to use this retirement fund is handed over to government agencies [7,8]. In contrast, nowadays people mainly choose defined-contribution (DC) plans and individual retirement accounts (IRA) as their pension options. Research has shown that in the 1980s, only 40% of the U.S. private-sector retirement contributions went to DC pensions. But two decades later, 90% of the contributions are flowing to DC retirement accounts [9]. This shift pushes individuals to make a saving decision depending on their economic conditions, to allocate retirement assets rationally according to their risk tolerance, and to assume the responsibility of managing their retirement accounts to optimize their life cycle. With the spread of the DC plan, some benefits are brought to both the government and individuals [7]. For the government, this shift may help to reduce the burden of funding social benefits. While for individuals, they may have more obligations to make plans and decisions for their retirement based on their specific circumstances, instead of accepting the established pension policy passively. However, the reforms have also led to less liberal future pensions and caused more difficulties for individuals to understand [7]. Especially for those who are not good at planning or asset investment, arranging pension plans on their own will be more likely to lead to an impairment of their assets [8]. Therefore, in order to increase retirement income and improve the quality of retirement life, workers need to make suitable decisions in choosing the most effective way to make reasonable retirement plans.

However, retirement planning is not a simple process for consumers, for they must consider the uncertainty of the future. For instance, consumer longevity, investment return, pension income, and medical expenses need to be taken into consideration when planning for retirement [10]. In addition, the process of planning is associated with professional knowledge of financial markets, purchasing power, and complex economic calculations [8]. People who are not proficient in financial knowledge may find it difficult to understand the technical details of financial products and the risks involved, which may lead to suffering losses due to inaccurate investment choices [7]. Therefore, financial knowledge is required when consumer making their retirement plans. Previous literature has demonstrated that financial knowledge is associated with stock market participation [11], derivatives market participation [12], borrowing behavior [13], individual savings [14,15], retirement planning [16-18]. On the one hand, consumers with high financial knowledge will be more motivated to participate in retirement planning since the cost of collecting information is lower than those with low financial knowledge [19]. On the other hand, rich financial knowledge means a better understanding of financial assets, indicating that sophisticated people will be well equipped at grabbing opportunities and obtaining higher expected returns through diversified investment. Clark et al. [7] found that risk-adjusted annual expected returns were 130 basis points higher for the most financially

knowledgeable individuals than their peers, therefore financially knowledgeable people's enthusiasm for participating in retirement planning is also higher. However, most research has focused on the relationship between financial knowledge and savings. Very little research explored the effects of financial knowledge on the behaviors of consumers' retirement accounts. Accordingly, there should be far more research on this issue.

Utilizing the dataset of the United States, this study focuses on the relationship between financial knowledge and consumer retirement planning behaviors. As an advanced economy, the United States has established a relatively complete retirement system, which is the three-pillar retirement system. According to this system, the first pillar is Social Security, which is also called the Old-Age, Survivors, and Disability Insurance (OASDI) program. The second pillar is Public Employee Retirement Systems (PERS), which can be divided into defined benefit or defined contribution pension plans based on the payment method. The third pillar is the individual retirement plan, which includes various private pension plans offered by employers, insurance companies, and unions. Although the national retirement system is relatively sound, consumers' enthusiasm for retirement planning participation is not high. According to the 2018 National Financial Capability Study (NFCS) report, only 41% of respondents tried to figure out how much they need to save for retirement, and 58% of non-retirees had employer-provided or independent personal retirement accounts. And for low-income families (income less than $25,000), were even less optimistic about retirement planning, with only 19% trying to plan for retirement or have a retirement account. In addition, more than half of the respondents (51%) worried about the adequacy of funds during retirement and were not optimistic about their retirement life. From the perspective of financial knowledge, there are still a large number of financial illiteracies in the United States, although the American's financial knowledge level is relatively high compared with other countries around the world. More specifically, only 7% of the respondents were able to correctly answer all six questions related to financial knowledge in the survey, and 40% of the respondents answered at least four questions correctly. Furthermore, the financial literacy rate among Americans has decreased from 42% to 34% since 2009, indicating that the situation is not optimistic in the United States. Therefore, it is

of vital policy significance to improve the financial knowledge level of American residents, so as to stimulate individuals to make desirable retirement plans and improve the retirement situation at this stage.

Previous studies have examined the effects of financial knowledge on asset allocation, financial market participation, and household wealth [11,14,15,18]. This study focuses on the association between financial knowledge and consumer retirement planning behaviors. In terms of retirement planning, most studies concentrated on retirement intentions and retirement savings. Unlike prior research, this study paid much attention to consumers' retirement accounts, which can be invested and managed by individuals themselves. To be more specific, retirement planning is measured as whether consumers have retirement accounts and whether they regularly contribute to the account, so as to reflect the role of financial knowledge in retirement planning accurately. The result indicates that consumers with a high level of financial knowledge are more likely to have their retirement accounts and invest in the accounts actively. Due to the positive impact of financial knowledge on consumer retirement planning behaviors, financial education programs should be widely introduced and targeted at those who lack financial knowledge, such as the elderly and the under-educated [20-22].

The remainder of this paper is organized as follows. In section 2, prior studies on financial knowledge and consumer retirement are reviewed, and research hypotheses are proposed as well. In section 3, the methodology is presented, and the data source, variables as well as descriptive statistics of this study are displayed. Section 4 discusses the empirical results. Section 5 deals with conclusions and forwards policy implications.

2. LITERATURE REVIEW AND HYPOTHESIS

2.1 Previous Research on Financial Knowledge

Since Bernheim [23] first noticed that financial knowledge can explain the differences in household savings behaviors, financial knowledge has been increasingly highlighted in the fields of consumer finance. In recent decades, researchers have made great efforts to develop specific measures of financial

knowledge. Early research paid much attention to basic financial knowledge. To measure financial knowledge, Hilgert et al. [24] developed a set of true or false questions, but it was not a universal measuring method. Lusardi and Mitchell [3] designed three questions to test people's ability to calculate interest rates, their understanding of inflation, and risk diversification. This set of question not only was widely used in the Health and Retirement Study(HRS) and many other US national surveys such as the US National Financial Capability Study [8,25], but also played a substantial role in financial knowledge survey among different countries [11,16,26]. Subsequently, financial knowledge was divided into basic financial knowledge and advanced financial knowledge in some other research [25,27]. Based on these studies, basic financial knowledge examines consumers' ability to calculate and understanding concepts such as inflation, compound interest, the time value of money, and monetary illusion. While advanced financial knowledge measures the functions of the stock market, profitability, and liquidity of financial instruments, as well as the understanding of mutual funds and risk diversification, aiming to measure the knowledge related to financial investment and portfolio allocation. Furthermore, subjective financial knowledge had also been introduced, which was defined as respondent self-assessments of their financial knowledge [17,27]. Research shows that people tend to become overconfident and tend to overestimate their financial knowledge level [28,29]. In this study, financial knowledge was measured by six questions from National Financial Capability Study (NFCS), including compound interest rates (two questions), inflation, bond prices, mortgages, and risk diversification.

Research in the past few years has shown that financial illiteracy is still widespread around the world [3,18,25]. Based on a massive survey across 14 countries, INFE investigated the performance of financial knowledge in OECD countries, indicating that a low level of financial knowledge generally exists in nearly all OECD countries. Consistent results have been found in both developed countries and emerging markets, such as Germany, Finland, Italy, Russia, Australia, and China [17,21,27,28,30,31]. Financial illiteracy has been discovered not only to be widespread but also to be particularly targeted among certain groups of people. Literature shows that the level of financial knowledge can be affected by a great number of

factors, such as age, gender, race, income, and work status. Differences in these factors may lead to differences in the degree of financial knowledge [32]. A hump-shaped profile of financial knowledge over the life cycle was demonstrated in some research, revealing that the young and old have the lowest level of financial knowledge [33]. Men's level of financial knowledge usually performs better than women's [34,35]. Besides, financial knowledge is usually higher for employees with a high level of education than for the non-employed, for the latter is more likely to lack calculating skills and basic financial concepts knowledge [36]. To solve the problem of financial illiteracy, as many as 59 economies in the world are actively designing and implementing national strategies to improve financial education (OECD, 2015). Effective financial education program will act as an essential instrument to improve individual's financial knowledge, promote desirable financial behaviors, and boost their financial satisfaction [20,22,25,37].

In addition, previous work has emphasized that financial knowledge plays an essential role in informed consumer choice in a variety of settings, including financial market investment, borrowing behaviors, and individual savings. By prompting individuals to make reasonable financial decisions and desirable financial behaviors, financial knowledge has increasingly become a powerful guarantee for the accumulation of public wealth [3,38,39]. Research from several countries indicates that financial knowledge is closely associated with consumer financial market investments. Consumers with higher financial knowledge are more likely to participate in the financial markets and concentrate more on stock, mutual funds as well as financial derivatives [7,11,26,38,40]. Besides, rich financial knowledge has a vital effect to help consumers allocate assets reasonably and obtain higher returns [41]. Researchers have analyzed the reason for this effect. Utilizing an intertemporal portfolio choice model, Jappelli and Padula [42] found that financial knowledge may help investors reduce entry and transactional costs associated with financial markets. Furthermore, research demonstrated that more knowledgeable respondents reported better diversifying investments [43]. There is also evidence that financial knowledge affects consumer borrowing behavior. Subprime mortgages [44], costly mortgages [45], and high-cost borrowing [13,29] are usually associated with a low level of

financial knowledge. Moreover, consumers who perform undesirable in financial knowledge tend not to refinance their mortgages when interest rates are falling [46]. For individual savings, Bernheim and Garrett [37] argued that people would save more if they have received financial education and get rich financial knowledge.

2.2 Previous Research on Retirement Planning

Defined as the time when one ceases to perform his or her main job and begins to receive pension income from public or private sources, retirement represents a vital life experience for individuals [47]. Evidence shows that a great number of people in both developing and developed countries are not ready to retire due to insufficient savings and lack of retirement plans [48]. The issues of retirement planning and retirement saving have sparked considerable research interest and remained at the forefront of academic research across many countries, for retirement planning has a significant impact on household wealth [49]. For instance, it has been discovered that even a family with a small retirement plan can accumulate twice as much wealth as a family without any plan [18]. Moreover, reasonable and effective retirement planning behaviors usually link with a high level of consumer satisfaction [1].

The first theoretical research on retirement planning was conducted by Huebner [50], who first proposed the concept of life value. Huebner believed that when individuals estimate and manage their "life value", it is essential for them to make decisions based on the comprehensive consideration of life-long savings and consumption. Modigliani and Brumberg [51] further proposed the Life Cycle Hypothesis (LCH), which is the theoretical underpinning of retirement saving and planning. According to LCH, individuals plan their consumption and savings behaviors over a very long period. To obtain the optimal allocation of consumption and to achieve the maximization of utility, it is necessary for individuals to smooth expenditure patterns over their life cycle. When earning capabilities are in a high position, individuals will save a portion of their income as a reserve to maintain their living in low-income periods (such as retirement). Due to career development, the income potential becomes higher with the increase in working years, leading the saving capacity also increases over time. However, once the retirement age is reached, individuals

have to rely on their accumulated savings. Friedman [52] proposed the Permanent Income Hypothesis (PIH) that individuals should consider their current wealth level and future income when maintaining the consumption of their life cycle. Based on these theories, a rational and well-informed person will make a retirement plan to optimize his life cycle, such as reducing consumption and accumulating savings during periods of high income.

Studies have shown that the life cycle optimization process of retirement planning can be affected by demographic characteristics (such as gender, age, education level, and work status), consumer preferences (such as risk aversion), economic environment (such as investment risk-return and liquidity constraints) and social safety net benefits (such as the availability of welfare plans and social security income) [5,53,54]. More specifically, results from a great number of studies revealed that individual who is older, be male, gain a high-level education, and earn high income are associated with desirable retirement planning behaviors [2].

2.3 Consumer Financial Knowledge and Retirement Planning Behaviors

In the past few years, literature dealing with financial knowledge and retirement planning is well-established and count a large number of contributions, including whether financial knowledge can enhance individuals' awareness of retirement planning and promote people to take practical actions for retirement planning, such as saving for retirement or participating in retirement accounts. Among the early work on financial knowledge and retirement planning was that conducted by Lusardi. Using data from 1992 and 2004 Health and Retirement Study (HRS), Lusardi and Mitchell [3] found that financial knowledge has a positive impact on individuals' retirement planning awareness, which can help people to accumulate wealth. Subsequently, using data from the 2005 Dutch Central Bank Household Survey (DHS), Van Rooij et al. [18] explored the relationship between financial knowledge and practical actions for retirement planning by adding a question that whether respondents developed and contributed to a retirement saving plan. The result shows individuals with rich financial knowledge tend to save for retirement more actively. This can be explained that a high level of financial knowledge plays an important role in reducing planning costs, in other words, it helps to reduce the

economic and psychological barriers to obtaining information, calculating, and planning [55]. Similar conclusions have also been found in the study by Lusardi and Mitchell [8] using data from the 2009 National Financial Capability Study (NFCS). To further study the relationship between financial knowledge and retirement saving behaviors, subsequent research was carried out in different countries around the world. The similar results have also been found in China [21], Finland [28], Italy [30], Germany [17], Netherland [27], Chile [56] and Canada [16].

Another essential part of retirement planning is the participation of retirement accounts, including whether to have a retirement plan and the pension asset allocation of the retirement account. A generally accepted point is that the more financially knowledgeable are better able to understand the rules of the retirement system, pay lower investment costs in their retirement accounts, and better diversify their retirement assets [57,58]. Research shows that the more financially knowledgeable individuals are, the stronger possibility for them to join in defined contribution (DC) plans and contribute to retirement accounts [9,59,60]. In addition, the issue of the relationship between financial knowledge and portfolio allocation in retirement plans has also been explored, illustrating sophisticated investors are more likely to invest in risky assets and get a higher return. Using a unique dataset provided by a large financial institution, Clark et al. [7] found a positive correlation between financial knowledge level and the fraction of equity in participants' retirement portfolios. And risk-adjusted annual expected returns showed 130 basis points higher for the most financially knowledgeable individuals than their peers. Likewise, consistent results have been found in the studies by Clark et al. [9] and Mahdzan et al. [5], indicating that people with richer financial knowledge tend to hold more risky assets in their retirement accounts. Some research divided financial knowledge according to different standards, to further explore the effect of financial knowledge on retirement planning. By dividing financial knowledge into basic and advanced financial knowledge, Nguyen et al. [10] concluded that advanced financial knowledge affects choosing growth investing options for their retirement instead of conservation investing option. Lee and Hanna [61] took subjective financial knowledge into consideration, indication that objective financial knowledge was negatively related to early withdrawals from retirement accounts, while subjective financial knowledge was positively related to hardship withdrawals.

The discussion above shows that, previous studies have examined the possible effects of financial knowledge on consumer retirement planning behaviors. But when it comes to participation in retirement accounts, most of them did not divide retirement accounts into employer-provided and self-owned. In this study, retirement planning behaviors are measured by two indicators, namely "whether having own retirement account" and "whether contributing to the retirement account", to reflect the role of financial knowledge effectively. Based on the previous studies, this study proposes two hypotheses as follows:

H_1: Given economic resources and other control variables, consumers with a higher financial knowledge level are more likely to have their retirement accounts (like an IRA, Keogh, SEP, or any other type of retirement account) as compared to their counterparts.

H_2: Given economic resources and other control variables, consumers with a higher financial knowledge level are more likely to regularly contribute to their retirement accounts as compared to those with lower financial knowledge.

3. METHODOLOGY

3.1 Empirical Strategy

This study primarily aims to investigate the effect of consumer financial knowledge on retirement planning behaviors. According to the survey data, the variables of retirement planning behaviors are not continuous, indicating that a traditional OLS method may be related to problems of robustness and accuracy. To deal with this problem, the regression method for an ordered and discrete dependent variable is firstly conducted and then probit regressions are applied in which consumer retirement planning behaviors related variables serve as the dependent variables, and financial knowledge serves as the independent variable. To verify the robustness, this study conducts comprehensive methods such as estimation methods replacing and income outliers removing. Based on the hypotheses discussed above, the baseline empirical model is specified as follows:

$$\text{retir\_account}_i = \alpha_0 + \beta \times \text{fin\_know}_i +$$
$$\sum_{j=1}^{N} \gamma_j \times \text{cv}_{j,i} + \varepsilon_i \qquad (1)$$

$$\text{retir\_contri}_i = \alpha_0 + \beta \times \text{fin\_know}_i +$$
$$\sum_{k=1}^{N} \gamma_j \times \text{cv}_{k,i} + \varepsilon_i \qquad (2)$$

In Equations (1) and (2), $retir\_account$ and $retir\_contri$ represent consumer retirement planning behaviors from different perspectives, serving as dependent variables of this model. fin_know refers to the independent variable consumer financial knowledge, while *cv* indicates the control variables, including demographic characteristics and financial circumstance-related variables. In addition, *i* indicates the respondent, α_0 is the constant term, and β and γ_j are the coefficients of financial knowledge variable and control variables. More specifically, *N* stands for the number of control variables.

3.2 Data and Variables

The dataset in this study is from the survey data of the National Financial Capability Study (NFCS) in 2009, 2012, 2015, and 2018, reaching 108,310 samples in total. Conducted by the FINRA Investor Education Foundation, NFCS covers consumer financial behaviors from four aspects: Making ends meet, planning ahead, managing financial products and financial knowledge, and decision-making, aiming to measure and analyze the key indicators of consumer financial capabilities and evaluate how these indicators change with basic demographics, behaviors, attitudes, and financial literacy characteristics. The sample is distributed in 51 states across the United States, which can be considered to be nationally representative. The dataset incorporates the basic information of the household members, their financial knowledge level, and different retirement planning behaviors.

The dependent variables of this study are consumer retirement planning behaviors, measured by two related questions. The first one is associated with a retirement account, which can be organized through an employer (like a pension plan, TSP, or a 401(k)) or not through an employer (like an IRA, Keogh, SEP, or any other type of retirement account that can be set up by individuals themselves). This study used retirement account organized not through an employer to measure retirement planning behaviors, that is "Do you [or your spouse/partner] have any other retirement accounts NOT through an employer, like an IRA, Keogh, SEP, or any other type of retirement account that you have set up yourself?", with 1 represents having own retirement account and 0 stands for not having. Having a retirement account reflects consumers can independently arrange their investment in retirement accounts, which represents desirable retirement planning behaviors. The second one is "Do you [or your spouse/partner] regularly contribute to a retirement account like a [Thrift Savings Plan (TSP),] 401(k) or IRA?". If the respondent answers "yes" to this question, it shows a desirable retirement planning behavior, and the variable is encoded 1. The independent variable financial knowledge is measured by six related questions in the survey, involving interest rate calculation (two questions included), the understanding of inflation, bond prices, mortgages, and risk diversification. If the question can be answered correctly, it is encoded 1 and 0 otherwise. A comprehensive index measuring financial knowledge is constructed through the sum of six question scores, ranging from 0 to 6.

Based on the previous studies [7,8,21,25], the control variables in this study can be divided into demographic characteristics and financial circumstances. Demographic characteristics incorporate consumer gender (1 refers to male and 0 otherwise), age (six categories: 18–24, 25–34, 35-44, 45-54, 55-64, and 65 or elder), education status (three categories: high school graduate or lower, some college to bachelor's degree, postgraduate degree or higher), marital status (1 stands for married and 0 otherwise), the number of financially depended children, and family income. Variables associated with financial circumstances include financial market participation (1 represents investing in stocks, bonds, mutual funds, or other securities and 0 otherwise) and consumer desirable financial behaviors. More specifically, desirable financial behavior is measured by a sum of values of five related questions, including whether spending more than income, whether difficult to cover the expense, whether saving for emergencies, whether saving for children's college education and whether saving for retirement. If any of these questions can be answered correctly, it is encoded 1 and 0 otherwise. The values of the desirable financial behavior variable range from 0 to 6.

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Table 1. Variable specification

Variable label	Attribute
Whether having own retirement account	"Do you [or your spouse/partner] have any other retirement accounts NOT through an employer, like an IRA, Keogh, SEP, or any other type of retirement account that you have set up yourself?" 1- yes, 0- no
Whether regularly contributing to a retirement account	"Do you [or your spouse/partner] regularly contribute to a retirement account like a [Thrift Savings Plan (TSP),] 401(k) or IRA?" 1- yes, 0- no
Financial knowledge	A sum of 6 related questions including compound interest rates (two questions included), inflation, bond prices, mortgages, and risk diversification are applied to measure consumers' objective financial literacy
Gender	1-male, 0- female
Age	Six categories: 18–24, 25–34, 35-44, 45-54, 55-64, and 65 or elder
Education status	Three categories: high school graduate or lower, some college to bachelor's degree, postgraduate degree or higher
Marital status	1-be married, 0- not be married
Child	The number of financially dependent children
Family income	
Whether participating in the financial market	"Not including retirement accounts, do you [does your household] have any investments in stocks, bonds, mutual funds, or other securities" 1- yes, 0- no
Desirable financial behaviors	A sum of five questions including whether spending more than income, whether difficult to cover the expense, whether saving for emergencies, whether saving for children's college education and whether saving for retirement

3.3 Descriptive Statistics

Table 2 presents the results of the descriptive statistics. For the dependent variables, only 24.5% of the sampling respondents have their retirement accounts not through an employer, which implies that most respondents prefer to rely on government or employers when it comes to retirement planning, instead of making some active investments on their own in retirement accounts. A similar result can be presented for the second dependent variable, where only 23.5% of the respondents regularly contribute to a retirement account and have desirable retirement planning behaviors. Both of the results indicate there is still a lack of retirement planning awareness for consumers, for the result reflects that less than a quarter of respondents are willing to take active retirement planning. For the independent variable, the mean value of financial knowledge is 3.134 on a scale of 6, which is an intermediate level. It indicates that about half of the respondents have a high level of financial knowledge, but this financial knowledge level still needs to be strengthened.

For control variables, the results of descriptive statistics reveal that 45.1% of the respondents

are male, and 55.1% of the respondents are married. Besides, 70.8% of the sampling families have one or more financially dependent children. Moreover, age distribution reflects that 10.8%, 17.5%, 17.4%, 19.2%, 17.6% and 17.5% of the respondents whose ages were in the range of 10-20, 20-30, and 30-40, respectively. When it comes to education status, 59.4% of the respondents do not go to college, 22.6% get a college education and have Bachelor's degree, 11.3% choose to study further and got a Postgraduate degree or higher, implying a low level of education. As for variables related to financial circumstances, only 34% of the respondents choose to participant in the financial market. For consumer financial behaviors, the mean value of the desirable financial behaviors index, which is measured by 5-point scales, is 2.129, which implies a relatively low degree of consumer financial market performance.

4. EMPIRICAL RESULTS

4.1 Results of Bivariate Analyses

Table 3 reports the results of correlations between consumer financial knowledge and consumer retirement planning behaviors, as well as the control variables associated with financial

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Whether having own retirement account	108,310	0.245	0.430	0	1
Whether regularly contributing to a retirement account	108,310	0.235	0.424	0	1
Financial knowledge	108,310	3.134	1.565	0	6
Gender	108,310	0.451	0.498	0	1
Age 18 to 24	108,310	0.108	0.311	0	1
Age 25 to 34	108,310	0.175	0.380	0	1
Age 35 to 44	108,310	0.174	0.379	0	1
Age 45 to 54	108,310	0.192	0.394	0	1
Age 55 to 64	108,310	0.176	0.381	0	1
Age 65 or older	108,310	0.175	0.380	0	1
High school or lower	108,310	0.594	0.491	0	1
Some college to Bachelor's degree	108,310	0.226	0.418	0	1
Postgraduate degree or higher	108,310	0.113	0.316	0	1
Marital status	108,310	0.551	0.497	0	1
Child	108,310	0.708	1.080	0	4
Family income	108,310	4.348	2.072	1	8
Whether participating in the financial market	108,310	0.340	0.474	0	1
Desirable financial behaviors	108,310	2.129	1.318	0	5

Source: The results of descriptive statistics are from the dataset of NFCS in 2009, 2012, 2015, 2018

circumstances. Most correlations are as expected. Based on the analyses, consumer financial knowledge is positively correlated to retirement planning behaviors. More specifically, the correlated coefficient of financial knowledge to the variable whether having own retirement account and whether regularly contributing to a retirement account are 0.280 and 0.195 at a significance level of 1%, respectively. In addition, control variables associated with financial circumstances all perform positive and significant associations with retirement planning behaviors, for the coefficient of participating in the financial market and desirable financial behaviors to whether having own retirement account are 0.408 and 0.373 at a significance level of 1%, respectively. Similar results can be found in the correlation between whether regularly contributing to a retirement account and the two control variables, with the coefficient are 0.245 and 0.365 at a significance level of 1%, respectively.

4.2 Consumer Financial Knowledge and Retirement Planning Behaviors

Table 4 displays the estimation results of the regressions of consumer financial knowledge on retirement planning behaviors, which is measured by whether having own retirement account and whether regularly contributing to a retirement account. In Column (1), only control variables are involved. In Columns (2) and (3), whether or not consumer have their retirement

account (IRA, Keogh, SEP, or any other type of retirement) is incorporated. More specifically, OLS regressions are utilized in Columns (1) and (2), while probit regression is performed in Column (3), aiming to improve the accuracy and robustness of the estimated results. Furthermore, in Column (4), whether consumers regularly contribute to a retirement account is also added to represent retirement planning behaviors. To eliminate the impacts of state heterogeneity on estimation results, the dummy variable of the state is controlled in all of the estimations.

Among the control variables in Column (1), most of them are statistically significant at 1% significance level. Accordingly, the coefficient of gender is statistically positive. Compared with female consumers, male consumers are more likely to have their retirement accounts. Besides, the coefficients of different age ranges are significantly negative, indicating older consumers tend to perform better retirement plans. But the trend of this negative correlation is slowing down as age increases, and the coefficient is not significant at age 55 to 64. Education status also plays an essential role in consumer retirement planning behaviors. The positive coefficients of the two education-related variables reflect that higher education tends to lead to desirable retirement planning habits. In terms of marital status, consumers who are married present a higher association with having retirement accounts, for the coefficient is positive at 1% significance level. Concerning the number of

Table 3. Correlations between consumer financial knowledge and consumer retirement planning behaviors

Variables	Have a retirement account	Regularly contribute to a retirement account	Financial knowledge	Family income	Participating in the financial market
Regularly contribute to a retirement account	0.473***				
Financial knowledge	0.280***	0.195***			
Family income	0.334***	0.371***	0.351***		
Participating in financial market	0.408***	0.245***	0.304***	0.397***	
Desirable financial behaviors	0.373***	0.365***	0.306***	0.485***	0.422***

Notes: Sample size = 108,310. Besides, ***, ** and * denote statistical significance at 1%, 5% and 10%, respectively

Table 4. Results of regressions of consumer financial knowledge on retirement planning behaviors

Variables	(1)	(2)	(3)	(4)
Financial knowledge		0.023***	0.107***	0.040***
		(0.001)	(0.004)	(0.004)
Male	0.005**	-0.007***	-0.035***	0.027***
	(0.002)	(0.002)	(0.010)	(0.010)
Age 25 to 34	-0.094***	-0.085***	-0.356***	0.701***
	(0.003)	(0.003)	(0.016)	(0.017)
Age 35 to 44	-0.086***	-0.083***	-0.347***	0.698***
	(0.004)	(0.004)	(0.016)	(0.017)
Age 45 to 54	-0.064***	-0.064***	-0.269***	0.706***
	(0.003)	(0.003)	(0.015)	(0.016)
Age 55 to 64	-0.004	-0.008*	-0.042***	0.550***
	(0.004)	(0.004)	(0.014)	(0.015)
Some college to Bachelor's degree	0.105***	0.105***	0.467***	0.494***
	(0.003)	(0.003)	(0.012)	(0.011)
Post graduate degree or higher	0.190***	0.180***	0.643***	0.623***
	(0.004)	(0.004)	(0.014)	(0.014)
Being married	0.022***	0.020***	0.077***	-0.055***
	(0.003)	(0.003)	(0.011)	(0.011)
Number of financially depended children	-0.012***	-0.010***	-0.056***	0.015***
	(0.001)	(0.001)	(0.005)	(0.005)
Family income	0.026***	0.023***	0.108***	0.193***
	(0.001)	(0.001)	(0.003)	(0.003)
Participate in the financial markets	0.241***	0.230***	0.748***	0.257***
	(0.003)	(0.003)	(0.011)	(0.011)
Desirable financial behaviors	0.058***	0.055***	0.231***	0.243***
	(0.001)	(0.001)	(0.004)	(0.004)
Constant	-0.057***	-0.099***	-2.400***	-3.092***
	(0.010)	(0.010)	(0.039)	(0.040)
State fixed	Yes	Yes	Yes	Yes
Observations	108310	108310	108310	108310
Adjusted R^2	0.266	0.272		
Pseudo R^2			0.267	0.242

Notes: Reference categories are a high school or lower, and age 18 to 24. In addition, ***, **, and * represent 1%, 5%, and 10% significance levels, respectively, and the data in parentheses is the robust standard error. For OLS regression utilized in Columns (1) and (2), the statistics of adjusted R^2 are reported. Additionally, for probit regression, the statistics of pseudo R^2 are reported

Table 5. Results of robustness check

Variables	(1)	(2)	(3)	(4)
Financial knowledge	0.187***	0.074***	0.109***	0.036***
	(0.006)	(0.006)	(0.004)	(0.004)
Male	-0.062***	0.046***	-0.053***	0.009
	(0.018)	(0.017)	(0.011)	(0.011)
Age 25 to 34	-0.643***	1.279***	-0.385***	0.731***
	(0.028)	(0.030)	(0.017)	(0.018)
Age 35 to 44	-0.624***	1.271***	-0.360***	0.740***
	(0.029)	(0.030)	(0.018)	(0.018)
Age 45 to 54	-0.490***	1.277***	-0.273***	0.753***
	(0.026)	(0.028)	(0.016)	(0.017)
Age 55 to 64	-0.089***	0.999***	-0.055***	0.576***
	(0.024)	(0.028)	(0.015)	(0.017)
Some college to Bachelor's degree	0.850***	0.891***	0.476***	0.492***
	(0.020)	(0.020)	(0.012)	(0.012)
Post graduate degree or higher	1.131***	1.079***	0.640***	0.609***
	(0.025)	(0.024)	(0.015)	(0.015)
Being married	0.137***	-0.089***	0.051***	-0.089***
	(0.020)	(0.020)	(0.012)	(0.012)
Number of financially depended children	-0.101***	0.016*	-0.052***	0.015***
	(0.010)	(0.009)	(0.006)	(0.005)
Family income	0.187***	0.338***	0.108***	0.199***
	(0.006)	(0.006)	(0.004)	(0.004)
Participate in the financial markets	1.286***	0.433***	0.749***	0.258***
	(0.019)	(0.019)	(0.011)	(0.012)
Desirable financial behaviors	0.408***	0.422***	0.238***	0.245***
	(0.008)	(0.008)	(0.005)	(0.005)
Constant	-4.174***	-5.436***	-2.405***	-3.100***
	(0.069)	(0.071)	(0.043)	(0.044)
State fixed	Yes	Yes	Yes	Yes
Observations	108310	108310	88330	88330
Pseudo R^2	0.267	0.242	0.241	0.203

Notes: Reference categories are a high school or lower, and age 18 to 24. In addition, ***, **, and * represent 1%, 5%, and 10% significance levels, respectively, and the data in parentheses is the robust standard error

financially dependent children, families without children that need to be funded show a tendency to have their retirement accounts, for they cannot rely on their children for future retirement life. Meanwhile, families with a high level of annual income are significantly positive to have retirement accounts. As for variables related to financial circumstance, consumers who actively participate in the financial market and have desirable financial behaviors are more willing to have their retirement accounts and invest retirement assets in accounts, for the coefficients of whether participating in the financial market and whether having a desirable financial behavior are statistically positive at a significance of 1%.

Results in Columns (2) and (3) implies that consumers who have a high level of financial knowledge tend to have their retirement accounts, with positive coefficients at 1% significance level, which is consistent with H_1. To

further investigate the association between consumer financial knowledge and their retirement planning behaviors, whether consumer regularly contributes to a retirement account is added. Columns (4) reports that high financial knowledge plays a significant role in pushing consumers to regularly contribute to a retirement account and form desirable retirement planning behaviors, which is as hypothesized in H_2. This can be explained that financial knowledge has the power to help reduce the economic and psychological barriers when consumers obtain information, calculating, and planning, so that it will be easier for them to make comprehensive retirement plans.

4.3 Robustness Check

To further examine the robustness of the estimation results, a series of additional regressions are conducted in this section. Firstly, the probit regressions are replaced by logit

regressions. Secondly, this study eliminates the outliers of income by dropping sampling families whose annual income is less than $15,000 or greater than $150,000. To eliminate the impacts of state heterogeneity on estimation results, the dummy variable of the state is controlled in all of the estimations.

Columns (1) and (2) represent the results of replacing the estimation approach. The coefficients of consumer financial knowledge to whether having own retirement account and whether regularly contributing to a retirement account are both positive and significant at 1% significance level. In Columns (3) and (4), after removing income outliers, the coefficients are still positive and significant, which is consistent with the prior estimation. The unchanged results indicate that there is a robust relationship between consumer financial knowledge and their retirement planning behaviors.

5. CONCLUSIONS AND IMPLICATIONS

With the development of financial industries in the past decades, new financial products and services have emerged, boosting the tremendous changes of the retirement system. One of the most significant changes is that individuals are increasingly required to take on responsibility for managing their retirement accounts, implying that decisions making on saving, investing, and wealth accumulation have been shifted to workers and retirees. This shift requires consumers to gain more financial knowledge to make effective decisions and management, and finally improve the efficiency of retirement planning. Therefore, utilizing the data from the NFCS in 2009, 2012, 2015, and 2018, this study aims to investigate the impact of financial knowledge on their retirement planning behaviors.

Results from empirical evidence suggest that consumer financial knowledge presents a positive effect on retirement planning behaviors. More specifically, consumers with a higher level of financial knowledge are more likely to have a retirement account and regularly contribute to a retirement account, which is in line with the hypotheses. This can be explained that consumers with high financial knowledge find it easier to understand the technical details of financial products and the risks involved, which helps them in obtaining information, calculating, and planning. In addition, to check the robustness of the results, a series of additional

regressions such as replacing the estimation approach and removing income outliers are conducted. The unchanged results present that there is a robust relationship between consumer financial knowledge and their retirement planning behaviors.

Based on the conclusions, measures to improve consumers financial knowledge level and guide consumers to make reasonable retirement planning are strategically highlighted from the following perspectives: First, financial education should be emphasized and funded by concerned government institutions, to help consumers understand the financial market, recognize financial products, and make comprehensive financial investments. In the process of promoting the popularization of financial knowledge, it is especially essential to consider the heterogeneity of the groups and design targeted popularization programs to meet the needs of different groups, due to the significant differences in the financial knowledge structure of different life cycles, income structures, genders, and occupational groups. Second, to reduce financial illiteracy and promote the popularization of financial knowledge, the publicity of financial knowledge in society should also be attached to great importance. While actively promoting financial institutions to carry out financial education works, it is also necessary to make full use of the existing education system and media channels to promote financial knowledge and improve the financial literacy of consumers. Third, improve the existing retirement system and develop targeted insurance products and services, which is positive to provide consumers with rich retirement asset allocation options and boost consumers to actively make retirement plans while promoting the improvement of consumer financial knowledge.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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