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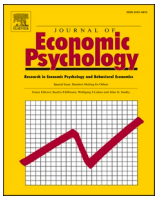

Cognitive abilities, self-efficacy, and financial behavior☆

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ABSTRACT

This paper investigates the effect of cognitive abilities on financial behavior among older adults. Using the U.S. Health and Retirement Study, I find that cognitive abilities significantly affect financial behavior through two channels: *ability* and *self-efficacy*. People with higher cognition scores achieve better financial outcomes. This positive association is especially strong in tasks having high demand of cognitive abilities, which confirms the *ability* channel of the cognitive ability effect. In addition, there is evidence for the *self-efficacy* channel as a secondary source of cognitive influence. Lower cognitive abilities decrease people's sense of self-efficacy, which, in turn, significantly decreases financial management efficiency. The findings have important policy implications, specifically that more effort is needed to assist the growing older population through the cognitive aging process and that noncognitive skills, as a secondary source of influence, also warrant attention.

1. Introduction

The older population in the United States has increased dramatically (Johnson, 2020). This older population is taking greater responsibility for managing a substantial amount of wealth accumulated throughout the lifetime. However, unsatisfying financial outcomes, such as great indebtedness, credit transaction errors, and investment decisions that lead to weak performance, have been observed among older adults (Agarwal et al., 2009; Korniotis and Kumar, 2011; Lusardi, Mitchell and Oggero, 2019). Financial mistakes in the older population can potentially jeopardize the accumulated retirement wealth and have wide-ranging impacts on society (Agarwal and Mazumder, 2013). Yet, despite the growing salience of the issue, our understanding of factors that contribute to financial management inefficiency among older adults is limited. This paper focuses on the interplay of cognitive and noncognitive skills in determining financial behavior among older adults.

Cognitive abilities can influence financial behavior through two channels: *ability* and *self-efficacy*. The *ability* channel refers to the ability required for optimal financial decision making such as information processing and problem-solving ability, memory function, and mathematical skills. Cognitive abilities can be expected to reflect individual ability differences and help explain variations in financial outcomes. In regard to the *self-efficacy* channel, individual cognitive abilities and consequent accomplishments can significantly affect people's belief in their ability to control and influence various aspects of life, namely, self-efficacy; people with lower self-efficacy expect less benefit from making efforts in the present, show less persistence in regard to financial difficulties, and thus achieve

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fewer financial goals and undergo a lower quality of financial decisions (Bandura, 1986, 1991, 1994; Lippke, 2017; Kuhnen and Melzer, 2018; Asebedo and Payne, 2019). Given the widespread cognitive aging observed across older populations and its potential influence on older adults' well-being, both financially and psychologically, it is particularly important to understand the way the cognitive effects work on financial behavior among the older population (Craik and Salthouse, 1992).

Using the data from the U.S. Health and Retirement Study (HRS), this paper investigates the *ability* and the *self-efficacy* channels through which cognitive abilities influence older adults' financial behavior. The dataset contains information on respondents' financial behavior, income, wealth, employment, and demographic characteristics. More importantly, it contains measures of cognition and self-efficacy. The results show that a higher cognitive score is associated with better performance based on six financial behavior indicators. The effect is especially stronger among tasks that require more information processing and analytical ability (diversifying one's portfolio, growing financial wealth, and following the stock market) than routine tasks (having enough money to buy the food needed, preventing financial distress, and making timely mortgage payments). These findings confirm the presence of the *ability* channel of the cognitive ability effect.

In addition, the results provide evidence of a secondary *self-efficacy* channel. Cognition positively affects self-efficacy, and self-efficacy also exerts a significant effect on financial behavior. That is, when the older population experiences cognitive aging, they suffer not only from a weakening cognitive capacity but also from a decline in self-belief in their ability to control and manage various aspects of life, which, in turn, significantly lowers financial management efficiency. This paper not only confirms the effect of cognitive abilities on financial behavior but also explains the underlying mechanism. The findings have important policy implications, specifically that more effort is needed to assist the growing older population through the widespread cognitive aging process and that noncognitive skills, as a secondary source of influence, also warrant attention.

Examining the two channels of the cognitive ability effect is a challenging task due to potential identification problems. I employ several estimation models—Blinder-Oaxaca decompositions, structural equation model, instrumental variable analysis, and first difference estimation—to identify and confirm the direct effect of cognitive ability and the indirect effect, through self-efficacy, on financial behavior. In the baseline analysis, I control for education, income, wealth, and risk preference along with other determinants of financial behavior. I apply residential region and time fixed effects to control for local and time-variant effects. Taking advantage of the longitudinal datasets, I use lagged cognition and self-efficacy measures in robustness tests to examine the influence of reverse causality. I also use a two-stage least-squares (2SLS) regression method, in which respondents' participation in card or word games is used as instrument for cognition, and self-assessment of control in social life is used as instrument for self-efficacy, to investigate the endogeneity bias caused by omitted variables. I adopt first difference estimation to exclude the possibility of bias from family background along with other time-invariant unobserved heterogeneity. Finally, this paper adopts direct measures of cognition instead of using proxies like age to investigate cognitive effects, and thus rules out confounding birth cohort effects and other age-induced explanations (Agarwal et al., 2009; Korniotis and Kumar, 2011).

This study contributes to the literature in several ways. It empirically explores the underlying mechanism of the cognitive ability effect by investigating the interplay of cognitive and noncognitive skills in determining financial behavior. Previous studies on the relationship between cognition and financial behavior used age as a proxy for cognitive abilities, thus making it difficult to further explore the mechanisms that drive the effects (e.g., Agarwal et al., 2009; Korniotis and Kumar, 2011). The few studies that used direct measures on cognition did not specifically focus on the drivers of the cognitive ability effect; nor did they consider noncognitive skills as a potential source of influence. This paper not only confirms the significant influence of cognition on older adults' financial behavior by using direct measures of cognition, but also points out that ability is not the only source of influence; noncognitive skills also can be affected by cognitive differences and consequently change individuals' financial behavior.

This paper also contributes to the emerging literature that highlights the role of noncognitive skills in explaining differences in household financial decisions (e.g. Neymotin, 2010; Abreu and Mendes, 2012; Tang and Baker, 2016). Although a wide range of psychological and emotional factors have been studied, self-efficacy—the fundamental perception that individuals hold about their abilities to influence various aspects of life—has received limited investigation in regard to its association with financial behavior (Kuhnen and Melzer, 2018). This study adds to this line of work by showing the effects of self-efficacy on wide-ranging financial behavior. Further, it demonstrates the role of cognitive abilities in determining self-efficacy, especially when older adults experience cognitive aging.

Finally, this study contributes to the literature on retirement security by improving our understanding of the challenges the older adults face. Previous studies investigating ways to improve financial management efficiency in the older population have mainly focused on educational programs, professional advisory services, and helpful nudges targeted at mitigating the negative impacts of deteriorating cognitive abilities (Agarwal et al., 2009; Finke, Howe and Huston, 2017). Results in this study suggest that noncognitive skills, such as self-efficacy, could be another source of interventions. Educational programs and professional advisory services, complemented by efforts to build individuals' self-efficacy, will likely lead to more effective outcomes.

The remainder of this paper is organized as follows: Section 2 provides a review of the literature and the development of testable hypotheses, Section 3 presents the data and descriptive statistics, Section 4 contains the results from baseline analysis and robustness tests, and Section 5 provides conclusions and policy implications.

2. Literature review and hypotheses

2.1. The ability channel

The financial decision-making process involves information retrieval, processing and integration, mathematical calculation, and

problem analysis and solving, all of which are largely determined by cognitive abilities. For example, memory, a critical component of cognitive ability measure, is related to numeracy, information processing ability, conditional probability judgments and financial knowledge acquisition (Spaniol and Bayen, 2005; Korniotis and Kumar, 2011; Gamble et al., 2015). Other cognitive functioning such as mathematical, verbal, recall, and logical skills contributes to stock market participation and portfolio choice decisions (Christelis, Jappelli and Padula, 2010; Grinblatt, Keloharju and Linnainmaa, 2011). Bruine de Bruin, Parker and Fischhoff (2012) also pointed out that decreased fluid cognitive ability at older ages is linked to worse performance on tasks that require reasoning, pattern recognition and problem solving. Therefore, it is expected that cognitive abilities directly affect older adults' financial behavior through the *ability* channel.

H1: Higher cognitive abilities predict more efficient financial behavior, after controlling for other determinant factors of financial behavior.

Further, if cognitive abilities influence financial behavior through the *ability* channel, then more "information-intensive" decisions should have a stronger link with cognitive abilities (Christelis, Jappelli and Padula, 2010). For example, when making investment and portfolio choice decisions, individuals need to understand various financial products, calculate performance measures, analyze complex problems and find optimal solutions, all of which are considered "information-intensive" activities. This type of financial decisions is expected to have higher demands for the ability to retrieve, integrate and process information than basic financial tasks such as paying bills on time. Previous literature has provided empirical evidence on the link between cognitive abilities and investment, portfolio choice and wealth management decisions (Christelis, Jappelli and Padula, 2010; Grinblatt et al., 2011; Kim et al., 2012). In particular, Korniotis and Kumar (2011) summarized that weakening memory and attentional ability adversely affect older adults' ability to process and integrate information appropriately, which leads to worse performance in financial decisions that require effective processing of information such as investment decisions. Therefore, by testing the varying cognitive effects on financial behavior with different degrees of dependence on cognitive abilities, the *ability* channel through which cognitive abilities work on financial behavior can be further confirmed.

H2: The effect of cognitive abilities on financial behavior is stronger in decisions demanding more cognitive abilities.

A small but growing body of research has investigated and confirmed the effect of cognitive abilities on various financial decisions and skills. For example, Agarwal and Mazumder (2013) found that people with higher cognition test scores are less likely to make mistakes in their usage of credit card balance transfer offers and home equity loan applications. Grinblatt et al. (2011) and Christelis, Jappelli and Padula (2010) provided evidence on the link between cognitive abilities and stock market participation, portfolio choice and investment performance. Korniotis and Kumar (2011) concluded that older investors' investment skills decline with age due to the adverse effects of cognitive aging. Gamble et al. (2015) showed that a decrease in cognition score leads to a decrease in financial literacy. In addition, evidence from aging literature indicates that cognitive function declines sharply at older ages (Salthouse, 2009). Cognitive aging is the hurdle older population particularly needs to face in financial decision making. This paper adds to the literature by adopting a direct measure of cognition to mitigate estimation bias such as birth cohort effects. It investigates the varying cognitive effects on wide ranging financial behavior with different degrees of dependence on cognitive abilities, so as to confirm the *ability* channel summarized in hypothesis H2. It also explores the channels through which cognitive effects occur and considers the interplay of cognitive and noncognitive effects in the process.

2.2. The self-efficacy channel

Self-efficacy refers to the belief in one's own capacity to execute behavior to influence various aspects of life (Bandura 1986, 1994, 1997). "Enactive mastery experience" is considered as the most influential source of self-efficacy; that is, successful experience with performance accomplishments helps build a sense of self-efficacy, while failures undermine it (Bandura, 1997). In the process of "reappraising capacities" in old age, witnessing weakening memory, mathematical, analytical, and attentional abilities as well as the failure to accomplish tasks due to cognitive aging can potentially exert negative impact on one's sense of self-efficacy (Bandura 1997; Lippke, 2017). For example, Forbes and Kara (2010) showed that one's self-assessment of investment knowledge significantly relates to investing self-efficacy. Thus, cognitive abilities are expected to have an impact on self-efficacy.

There are plausible reasons to expect a positive effect of self-efficacy on financial behavior, as well. Self-efficacy is associated with goal setting and attainment, accomplishment, initiation of behavior, coping efforts and persistence in the face of adverse experiences (Bandura, 1986, 1991; Lippke, 2017; Asebedo and Payne, 2019). These skills and qualities are expected to play a critical role in achieving optimal financial behavior. Nevertheless, empirical investigation on the effect of self-efficacy on financial behavior is limited. A few studies empirically tested the link between self-efficacy and choice of financial products among women (Farrell, Fry and Risse, 2016), financial market participation and wealth accumulation (Chatterjee, Finke and Harness, 2011), and financial distress prevention (Kuhnen and Melzer 2018). However, the interplay of cognitive abilities and self-efficacy in determining financial behavior is unexplored.

H3: Higher cognitive abilities predict higher self-efficacy, which leads to more efficient financial behavior, after controlling for other determinant factors.

3. Data and summary statistics

3.1. Data

This study uses the longitudinal dataset provided by HRS, a nationally representative multi-disciplinary study of Americans over age 50. The dataset contains information on respondents' demographic and financial characteristics. More importantly, it contains measures of cognition and self-efficacy. This paper combines HRS surveys in areas of cognition, psychosocial characteristics, and financial behavior during the period of 2008–2016. All of the surveys adopted by this study take place every two years, except for the psychosocial data. The Psychosocial and Lifestyle Questionnaire is administered based on a random sample consisting of 50% of the core panel respondents, for which each subsample rotates every four years. Thus, a respondent in the selected sample has a four-year interval between data points, and each wave contains half the sample respondents (Smith et al., 2017; Asebedo and Payne, 2019). In the survey, some households have more than one respondent, and certain financial behavior questions were taken at the household level. It is possible that some respondents are not the financial decision makers of the household. To address this issue, I keep respondents from single-respondent households and respondents who answered household-level financial questions in couple households, who presumably participated in household financial decisions. The selected sample has 9,182 observations (observation unit is respondent by year). There are 2,026 observations in 2016, 2,567 observations in 2014, 1,503 observations in 2012, 1,967 observations in 2010, and 1,119 observations in 2008. I describe the major measures next.

3.1.1. Financial behavior

I create six indicators of financial behavior: (1). whether the household could meet monthly payments without difficulty (indicator = 1 if respondent answered not at all difficult or not very difficult to meet monthly payments; indicator = 0 if respondent answered somewhat, very or completely difficult); (2). whether the household always had enough money to buy the food needed (indicator = 1 if respondent answered yes; indicator = 0 otherwise); (3). whether the household made timely mortgage payments (indicator = 1 if household didn't fall more than two months behind on mortgage payments; indicator = 0 otherwise); (4). whether the household held more than one type of financial asset for portfolio diversification; (5). whether the respondent closely followed the stock market (indicator = 1 if respondent answered very closely or somewhat closely followed the stock market; indicator = 0 if respondent answered not at all); and (6). whether the growth rate of household financial wealth exceeded the median growth rate of the same age group in the past two years. Each of these indicators has a value of 0 or 1. I take the sum of these six indicators to create the "financial behavior" score that ranges from 0 to 6. I also create a "routine tasks" score by adding the first three indicators and an "advanced tasks" score by adding the last three indicators. "Advanced tasks" are expected to have a higher demand for cognitive abilities than "routine tasks." See the Appendix for the survey questions.

I select the six indicators as they reflect the efficiency of respondents' financial management in the areas of cash flow management, budgeting, portfolio choice, investment and wealth accumulation, all of which are crucial to the retirement security of the older population. For example, financial strains and hardship among older adults are shown to have significant economic and psychological consequences and have been the focus of assistance programs aimed at improving financial well-being of the older population (Krause, 1987; Kahn and Pearlin, 2006; Lee et al., 2021). Financial mistakes in investments and wealth management could also potentially jeopardize the accumulated assets for retirement (Korniotis and Kumar, 2011; Lusardi, 2012).

Although there are other important financial decisions such as insurance planning, retirement saving and debt management, I select these six indicators based on the following criteria in order to focus on the effects of cognitive abilities and self-efficacy on financial behavior. First, I include financial outcomes that are less prone to the influence from factors including lifecycle changes in financial management, unobserved age-driven variables, and workplace benefits. Excluding such behavior measures mitigates the omitted variable bias which could lead to a spurious relationship between financial behavior and cognition or self-efficacy. Second, I exclude measures that could be the outcome of financial decisions made long before the survey time. For example, although savings in retirement accounts is an important measure of financial outcome among the older population, it is the result of financial decisions throughout the career of the respondents. Regressing retirement savings on current cognition and self-efficacy scores could lead to biased estimates. Finally, I keep financial decision measures that can be reasonably classified as "routine tasks" versus "advanced tasks" with different degrees of dependence on cognitive abilities. "Advanced tasks" including active investment, portfolio choice and wealth management decisions, in general, have higher demands for information integration and processing ability, mathematical calculation, analytical and problem-solving skills than "routine tasks."

3.1.2. Cognition score

HRS provides a widely used measure of cognitive abilities, defined as the sum of the respondent's immediate and delayed word recall, serial 7 s, backwards counting, object naming, president/vice president naming, and date naming tests (McCammon et al., 2019). The original score from the cognition test ranges from 0 to 35, and I scale it to 0–100 for further analysis.

3.1.3. Self-efficacy score

In the Psychosocial and Lifestyle Questionnaire, respondents were asked 10 questions that focus on the personal sense of control in general and they are used to indicate individual's self-efficacy level. I follow Smith et al. (2017) and construct a self-efficacy score based on these 10 questions and scale it to 0–100. A higher self-efficacy score indicates a higher self-efficacy level.

3.1.4. Covariates

The covariates in the analysis include individual socio-demographic information like age, gender, ethnicity, marital status, education level and residential region. Since respondents' financial behavior, especially "routine tasks" can be affected by the income and poverty status of the respondents, I also control for household income, whether income is below the U.S. census poverty threshold and household wealth. In addition, the third indicator on mortgage payment is related to the home ownership and mortgage status of respondents. Thus, these two variables are included as control variables as well. Last, I control for individual employment status and risk preference. In particular, risk preference has been considered a fundamental determinant of financial decision making, especially in investment and portfolio management decisions (e.g. Donkers and van Soest, 1999; Kapteyn and Teppa, 2011). Dohmen, Falk, Golsteyn, Huffman, & Sunde, 2017 also found that people's willingness to take risks decreases from early adulthood to old age. Therefore, it's important to control for individual risk preference when examining the determinants of financial behavior among older adults.

3.2. Summary statistics

Summary statistics on all measures as well as covariates are shown in Table 1. The average financial behavior score is 4.2. Respondents score higher in routine tasks and lower in advanced tasks, which is consistent with the definition of advanced and routine tasks. The scaled cognition score has a mean of 64.48, and the self-efficacy score has a mean of 77.02.

The selected sample includes adults aged 51–104, and males comprise 41.65% of the sample. Of the respondents, 85.5% are white and 49.51% are married. Respondents have a mean of 13.15 years of education. The average household income is $58,506 with 5.91% of them below poverty threshold, and the average household net wealth is $541,006. The respondents have a mean risk-preference level of 2.84 out of 10 (0-unwilling to take any risks in financial matters; 10-fully prepared to take risks). Of the respondents, 81.75% own their house, 22.2% have mortgages, 21.4% are still employed, and 74.91% have retired. As for residence region, 14.71% live in the Northeast; 27.41% in the Midwest; 39.13% in the South; 18.66% in the West; and 0.09% in other areas. The population distribution across regions is consistent with the U.S. Census Bureau population statistics, which demonstrates the representativeness of the selected sample[1].

Fig. 1 provides a graph of the age pattern of the main variables: financial behavior, cognition, and self-efficacy. Both the "naïve analysis" and the "controlled analysis" are used to derive the age pattern, as in Agarwal et al. (2009). A "naïve analysis" simply calculates mean financial behavior, cognition and self-efficacy by age, ignoring the potential role of cohort and selection effects; whereas a "controlled analysis" uses intra-individual differences in adjacent waves to track the performance age pattern, thus eliminating the cohort and selection effects bias (Agarwal et al., 2009).[2] In Panel A, the quality of financial decisions is shown to decline with age, especially under "controlled analysis," whereby cohort effects and selection bias are controlled. The same declining pattern is found in cognition and self-efficacy in Panels B and C, respectively. These results are consistent with the literature on cognitive aging and declining financial outcomes among the older population (e.g., Agarwal et al., 2009; Korniotis and Kumar, 2011).

4. Effects of cognitive abilities on financial behavior

4.1. Cognitive abilities and financial behavior

In the baseline model, I use the cognitive score as the main explanatory variable to examine the effects cognitive abilities exert directly on financial behavior. Pooling the data from five waves of the survey from 2008 to 2016, I run the following regression:

$$Y_{i,t} = \alpha + \gamma_1 * Cog_{i,t} + \gamma_2 * efficacy_{i,t} + \gamma_3 * Z_{i,t} + \gamma_4 * F(t) + \gamma_5 * F(r) + \varepsilon_{i,t}, \quad (1)$$

where $Y_{i,t}$is the financial behavior score of individual i in year t; $Cog_{i,t}$ denotes individual i's cognition score in the same period; $efficacy_{i,t}$ is individual i's self-efficacy; and $Z_{i,t}$ represents individual demographic and financial characteristics, including age, gender, ethnicity, marital status, years of school, household income, poverty status, household wealth, home ownership, mortgage status, employment, and retirement status. I also include risk preference, which has impacts on individual financial behavior. Year dummies F(t) and residence region dummies F(r) are added to control for the local and time fixed effects. I cluster at the household level for robust standard errors.

As shown in Column (1) of Table 2, cognitive abilities have a significantly positive effect on financial behavior. A one-standard-deviation (12.42) increase in cognitive score leads to a 0.12 increase in the financial behavior score. To quantify the importance of

[1] United States Population Growth by Region 2010–2019 Table is available at https://www.census.gov/popclock/data_tables.php?component=growth.

[2] The method of "controlled analysis" is defined by Agarwal et al. (2009) as follows: calculate the average rate of performance change between adjacent survey waves: $\frac{1}{N_{\Omega(a)}}\sum_{i\in\Omega(a)}\frac{y_{i,w+1}-y_{i,w}}{a_{i,w+1}-a_{i,w}}$, where $y_{i,w}$ is the performance of individual i in HRS wave w, $a_{i,w}$is the age of individual i in wave w, a is the middle point between $a_{i,w+1}$and$a_{i,w}$, $\Omega(a)$ is the set of respondents with performance measures in two adjacent waves with ages at the middle point being a, and $N_{\Omega(a)}$ is the number of such respondents. Because this method requires a respondent to appear in at least two waves of the survey, and some survey questions to derive the main variables were asked among those who were aged 65+ or had never been interviewed before, the analysis ends up with respondents aged 65+.

Table 1
Summary Statistics.

	Mean	SD	Min	Max
Dependent Variables				
Financial behavior	4.20	1.21	0	6
Routine tasks	2.72	0.53	0	3
Advanced tasks	1.48	0.98	0	3
Independent Variables				
Cognition score	64.48	12.42	2.86	100
Self-efficacy score	77.02	18.34	0	100
Covariates				
Age	74.99	6.77	51	104
Male	41.65%			
White	85.50%			
Married	49.51%			
Years of school	13.15	2.68	0	17
Household income	$58,506	$93,621	0	$3,010,980
Below poverty threshold	5.91%			
Household wealth	$541,006	$1,008,056	-$1,495,000	$30,850,000
Home owner (yes = 1, no = 0)	81.75%			
Have mortgage (yes = 1, no = 0)	22.20%			
Risk preference	2.84	2.63	0	10
Employed (1 = yes, 0 = no)	21.40%			
Retired (1 = yes, 0 = no)	74.91%			
Residence region				
Northeast	14.71%			
Midwest	27.41%			
South	39.13%			
West	18.66%			
Other region	0.09%			
Number of observations	9,182			

Note: This table reports summary statistics of dependent variables: financial behavior score based on six financial behavior indicators, routine tasks score based on three routine task indicators, and advanced tasks score based on three advanced task indicators. It also reports summary statistics on major independent variables including cognition and self-efficacy scores and other covariates. The sample includes 9,182 observations during 2008–2016. The observation unit is respondent by year.

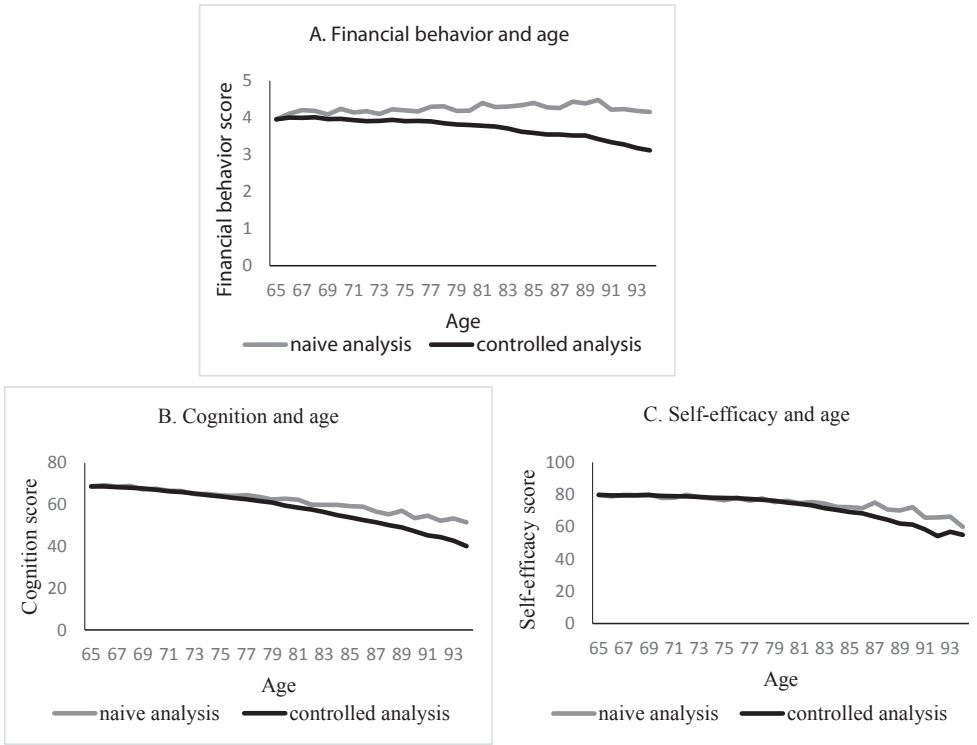

Fig. 1. Financial Behavior, Cognitive Abilities and Self-Efficacy by Age.

Table 2
Effects of Cognitive Abilities and Self-Efficacy on Financial Behavior.

	(1). Financial behavior		(2). Routine tasks		(3). Advanced tasks		(4). Financial behavior-lag cognition and self-efficacy		(5). Financial behavior-2SLS	
Cognition score	0.0097	***	0.0016	**	0.0081	***			0.0198	*
	(0.0011)		(0.0006)		(0.0009)				(0.0091)	
Self-efficacy	0.0076	***	0.0052	***	0.0023	***			0.0098	***
	(0.0007)		(0.0003)		(0.0006)				(0.0017)	
Lag cognition							0.0094	***		
							(0.0015)			
Lag self-efficacy							0.0067	***		
							(0.0009)			
Age	0.0211	***	0.0112	***	0.0099	***	0.0198	***	0.0270	***
	(0.0021)		(0.0010)		(0.0018)		(0.0028)		(0.0047)	
Male	0.1946	***	0.0674	***	0.1272	***	0.1915	***	0.2128	***
	(0.0290)		(0.0132)		(0.0240)		(0.0348)		(0.0379)	
White	0.2661	***	0.0762	***	0.1899	***	0.2974	***	0.2150	**
	(0.0385)		(0.0217)		(0.0294)		(0.0479)		(0.0653)	
Married	0.1082	***	0.0229		0.0853	**	0.1161	**	0.1070	**
	(0.0300)		(0.0140)		(0.0245)		(0.0355)		(0.0308)	
Years of education	0.0579	***	0.0096	***	0.0483	***	0.0619	***	0.0420	**
	(0.0059)		(0.0026)		(0.0048)		(0.0070)		(0.0143)	
Household income (in $1000)	0.0006	**	0.0002	***	0.0003	*	0.0007	**	0.0005	**
	(0.0002)		(0.0001)		(0.0001)		(0.0002)		(0.0002)	
Below poverty threshold	−0.4210	***	−0.2277	***	−0.1932	***	−0.4325	***	−0.3791	***
	(0.0564)		(0.0337)		(0.0413)		(0.0685)		(0.0686)	
Household wealth (in $1000)	0.0002	***	0.00004	***	0.0002	***	0.0002	***	0.0002	***
	(0.00003)		(0.00001)		(0.00003)		(0.00004)		(0.00003)	
Home owner (yes = 1, no = 0)	0.3440	***	0.1305	***	0.2135	***	0.3006	***	0.3281	***
	(0.0367)		(0.0188)		(0.0291)		(0.0435)		(0.0395)	
Have mortgage (yes = 1, no = 0)	−0.2896	***	−0.1390	***	−0.1506	***	−0.2915	***	−0.2980	***
	(0.0329)		(0.0159)		(0.0261)		(0.0412)		(0.0337)	
Risk preference	0.0334	***	−0.0012		0.0346	***	0.0369	***	0.0335	***
	(0.0053)		(0.0025)		(0.0043)		(0.0063)		(0.0053)	
Employed (1 = yes, 0 = no)	0.0657		0.0860	*	−0.0203		−0.0770		0.0440	
	(0.0684)		(0.0340)		(0.0530)		(0.0920)		(0.0701)	
Retired (1 = yes, 0 = no)	0.1589	*	0.0987	**	0.0602		0.0687		0.1543	*
	(0.0644)		(0.0321)		(0.0492)		(0.0854)		(0.0657)	
Residence region fixed effects	Yes		Yes		Yes		Yes		Yes	
Time fixed effects	Yes		Yes		Yes		Yes		Yes	
Number of observations	9,182		9,182		9,182		6,067		8,881	
Number of clusters	4,927		4,927		4,927		3,694		4,849	
R-Square	0.2635		0.1451		0.2143		0.2632			
First-stage min eigenvalue statistic									77.8983	
F statistics for endogeneity tests									4.1981	

Note: This table reports effects of cognitive abilities and self-efficacy on financial behavior. Dependent variable is financial behavior score based on six financial behavior indicators in columns (1), (4) and (5), financial behavior score based on three routine tasks in column (2) and financial behavior score based on three advanced tasks in column (3). Columns (1), (2) and (3) report estimated results from OLS regressions. Column (4) reports estimated result from OLS regression by using lag cognition and self-efficacy scores taken four years before the financial behavior measure as main explanatory variables. Column (5) reports the second stage results in the two-stage least squares (2SLS) regression. Standard errors clustered at the household level are shown in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

cognitive ability in determining financial behavior, I compare its effect with those of other controls. For example, the coefficient on household wealth (in $1,000) is 0.0002; a unit increase in cognitive score has the same effect of a $48,500 increase in household wealth on financial behavior. Thus, after controlling for self-efficacy, education, income, wealth, and risk preference, along with other individual demographic and financial characteristics, the effects of cognitive abilities on financial behavior are shown to be significantly positive. H1 is confirmed.

It's also found that other independent variables in Column (1) of Table 2 exert significant impacts on older adults' financial behavior. For example, self-efficacy positively affects financial behavior after controlling for the cognition score and other covariates, and the effect is statistically significant at 0.1% level. Risk aversion is shown to be an important determinant of older adults' financial behavior. More risk averse individuals have better financial outcomes in our analysis probably due to its impacts on portfolio choice and investment decisions.

4.2. Ability channel

The cognition score derived from memory, vocabulary and numeracy tests implies individual ability in information processing and integration, mathematical calculation, and problem analysis. Thus, results in Section 4.1 indicate that cognitive abilities directly affect financial behavior through the *ability* channel. To provide further evidence on the *ability* channel, I rerun Equation (1) with two different dependent variables: financial behavior scores in "routine tasks" and "advanced tasks." That is, I divide financial behavior into two groups based on their degrees of dependence on information processing and problem-solving ability. If cognitive abilities exert their influences on financial behavior through the *ability* channel, the effects are expected to be stronger among "advanced tasks" which require more cognitive skills. The results in Columns (2) and (3) of Table 2 show that cognitive abilities exert positive effects on both types of tasks; the effect is much larger on advanced tasks (0.0016 in Column (2) on routine tasks vs. 0.0081 in Column (3) on advanced tasks). The findings indicate that cognitive abilities directly affect financial behavior, and the effects are stronger among tasks that demand more information processing and problem-solving abilities, which is consistent with the hypothesis that cognitive abilities affect financial behavior through the *ability* channel. H2 is confirmed.

4.3. Secondary self-efficacy channel

As seen in Sections 4.1 and 4.2, cognitive abilities significantly affect financial behavior through the direct *ability* channel. The results also indicate that the effect of cognition is not primarily driven by its correlation with self-efficacy and other control variables; however, cognitive abilities could affect many of these variables, which, in turn influence financial behavior (Grinblatt et al., 2011). Hence, there could be secondary channels through which cognitive abilities influence financial behavior. For example, as summarized in Section 2.2, there are plausible reasons to expect that high-cognition individuals are more likely to believe in their abilities to influence their future, which leads to better financial behavior.

Table 3
Blinder-Oaxaca Decompositions of Secondary Channels of Cognitive Ability Effects on Financial Behavior.

	(1). Top vs. bottom centile		(2). Top vs. bottom quartile	
Self-efficacy	0.0972	***	0.0727	***
	(0.0187)		(0.0093)	
Years of education	0.2317	***	0.1705	***
	(0.0372)		(0.0173)	
Household income (in $1000)	−0.0100		0.0144	
	(0.0214)		(0.0098)	
Poverty status	0.0585	***	0.0385	***
	(0.0164)		(0.0072)	
Household wealth (in $1000)	0.1509	***	0.0960	***
	(0.0240)		(0.0134)	
Home owner (yes = 1, no = 0)	0.0945	***	0.0544	***
	(0.0182)		(0.0079)	
Have mortgage (yes = 1, no = 0)	−0.0618	***	−0.0421	***
	(0.0164)		(0.0076)	
Risk preference	0.0173	*	0.0132	**
	(0.0076)		(0.0041)	
Demographics	0.0858	*	0.0033	
	(0.0385)		(0.0168)	
Financial behavior score of higher cognition group	4.5531		4.4917	
Financial behavior score of lower cognition group	3.6379		3.8592	
Difference between groups	0.9152		0.6325	
Explained difference	0.6640		0.4209	
Unexplained difference	0.2512		0.2116	

Note: This table reports results from Blinder-Oaxaca Decompositions. Column (1) reports on analysis of financial behavior score difference between the lowest and highest centile cognition groups. Column (2) reports on the lowest and highest quartile cognition groups. Standard errors clustered at the household level are shown in parentheses.
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

To investigate the potential secondary channels through which cognitive abilities affect financial behavior, I first adopt the Blinder-Oaxaca decomposition method (Blinder, 1973; Oaxaca, 1973). The use of the method decomposes the difference in the means of a dependent variable between two groups into a part that is explained by group differences in the independent variables and a residual part that cannot be explained (Jann, 2008). Grinblatt, Keloharju and Linnainmaa (2011) employed this technique to investigate the secondary channels through which IQ influences stock market participation decisions. I follow their strategy and select two groups: those with the top centile of cognition score, with a mean financial behavior score of 4.55, and those with the bottom centile of cognition score, with a mean financial behavior score of 3.64. Then, the Blinder-Oaxaca decomposition method is employed to explore how much of the difference in financial behavior (0.92) is explained by the difference in self-efficacy and other control variables between these two groups.

The results presented in Column (1) of Table 3 indicate that group differences in self-efficacy can explain a significant portion of the difference in financial behavior between low- and high-cognition groups, holding other control variables fixed. Specifically, the difference in financial behavior scores between groups with top and bottom centile cognition scores is 0.9152; difference in self-efficacy between these two groups can account for 11% —derived by dividing self-efficacy coefficient by total financial behavior difference—of the financial behavior difference. For comparison, difference in wealth explains 16% of the outcome differences, and other control variables, such as risk preference, have less explanatory power than self-efficacy, except for education. Thus, a significant portion of the effects of cognitive abilities on financial behavior, reflected in the performance differences between two cognition groups, is due to cognition-related self-efficacy. Column (2) of Table 3 shows similar results when dividing groups by cognition scores in the lowest and highest quartiles.

Blinder-Oaxaca decompositions help to understand the cognition-related mechanism that influences financial behavior. Among the possible secondary channels, cognition-related difference in self-efficacy is found to be one of significant importance. It provides empirical support for the value of investigation into the secondary *self-efficacy* channel–cognitive abilities affect self-efficacy, which, in

Table 4
Effect of Cognitive Abilities on Self-Efficacy.

	(1). Baseline analysis		(2). Lag cognition		(3). 2SLS	
Cognition score	0.1659	***			0.7960	***
	(0.0204)				(0.1612)	
Lag cognition			0.1326	***		
			(0.0257)			
Age	−0.2119	***	−0.3479	***	0.0966	
	(0.0395)		(0.0485)		(0.0897)	
Male	1.6381	**	2.0527	**	3.2651	***
	(0.5331)		(0.6041)		(0.7049)	
White	−1.1818		−0.9841		−4.9402	***
	(0.6785)		(0.7852)		(1.1743)	
Married	−1.2124	*	−1.3266	*	−1.5519	**
	(0.5271)		(0.6022)		(0.5714)	
Years of education	0.4059	***	0.5029	***	−0.5113	*
	(0.0988)		(0.1103)		(0.2584)	
Household income (in $1000)	0.0070	***	0.0071	*	0.0051	*
	(0.0020)		(0.0031)		(0.0022)	
Below poverty threshold	−2.0460	*	−1.9557		0.7794	
	(0.9420)		(1.0852)		(1.2586)	
Household wealth (in $1000)	0.0011	***	0.0010	***	0.0009	***
	(0.0002)		(0.0003)		(0.0002)	
Home owner (yes = 1, no = 0)	2.6015	***	2.3632	**	1.8380	*
	(0.6621)		(0.7340)		(0.7450)	
Have mortgage (yes = 1, no = 0)	−0.0427		−0.4125		−0.5465	
	(0.5435)		(0.6619)		(0.5937)	
Risk preference	0.1538		0.1320		0.1633	
	(0.0940)		(0.1075)		(0.1018)	
Employed (1 = yes, 0 = no)	1.9459		−0.0292		1.4190	
	(1.2056)		(1.4056)		(1.3194)	
Retired (1 = yes, 0 = no)	−0.1860		−2.4125		−0.3555	
	(1.1429)		(1.3153)		(1.2452)	
Residence region fixed effects	Yes		Yes		Yes	
Time fixed effects	Yes		Yes		Yes	
Number of observations	9,182		6,484		8,974	
Number of clusters	4,927		4,008		4,876	
R-Square	0.0714		0.0687			
First-stage F statistic					133.5500	
F-statistic for endogeneity tests					18.0131	

Note: This table reports the effect of cognitive abilities on self-efficacy. Column (1) reports estimated results from OLS regression. Column (2) reports estimated results from OLS regression by using lag cognition score taken four years before the self-efficacy measure as main explanatory variable. Column (3) reports the second-stage results from the two-stage least squares (2SLS) regression. Standard errors clustered at the household level are shown in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

turn, influences financial behavior. To formally test for the *self-efficacy* channel, I first regress self-efficacy on cognitive score:

$$Efficacy_{i,t} = \alpha + \eta_1 * Cog_{i,t} + \eta_2 * Z_{i,t} + \eta_3 * F(t) + \eta_4 * F(r) + \varepsilon_{i,t}. \quad (2)$$

where $Efficacy_{i,t}$ refers to the self-efficacy level of individual i in year t. All other variables are the same as in Equation (1). As shown in Column (1) of Table 4, cognition has a significantly positive effect on self-efficacy. A one-unit increase in the cognition score leads to a 0.17-unit increase in self-efficacy. That is, older adults with lower cognitive abilities will have lower level of self-belief in their own abilities probably after realizing their incapacity to achieve certain accomplishments.

In the next step, I investigate the effect of self-efficacy on financial behavior. The results from Equation (1), shown in Column (1) of Table 2, demonstrate that self-efficacy significantly affects financial behavior, after controlling for the direct effect of cognitive abilities and a host of other control variables. The impact of self-efficacy is as significant as the one of cognitive abilities. A one-standard-deviation increase (18.34) in self-efficacy leads to a 0.14 increase in financial behavior, whereas a one-standard-deviation (12.42) increase in cognition score leads to a 0.12 increase in financial behavior score. The combined results from Equations (1) and (2) show that higher cognitive abilities predict higher self-efficacy, which, in turn, predicts improved financial behavior. That is, cognitive abilities could also exert influence on financial behavior through the secondary channel—self-efficacy. Thus, H3 is confirmed.

Finally, I adopt the structural equation model that simultaneously estimates Equations (1) and (2) to summarize the direct (*ability* channel) and indirect (through self-efficacy) effects of cognitive abilities on financial behavior found so far. As shown in Table 5, the direct effect represents the effect of cognitive abilities through the *ability* channel (the same as the coefficient for cognition in Column (1) of Table 2), and the indirect effect represents the effect of cognitive abilities through self-efficacy (the product of the coefficient for cognition in Column (1) of Table 4 and the coefficient for self-efficacy in Column (1) of Table 2); the total effect is the sum of these two effects. Both the direct and indirect effects of cognitive abilities are statistically significant, as shown in Column (1) of Table 5. That is, cognitive abilities significantly affect financial behavior both directly and indirectly through its influence on self-efficacy. These results confirm H1 and H3. In addition, a comparison of the results in Columns (2) and (3) of Table 5, in regard to the separate analyses of routine tasks and advanced tasks, shows that the direct effect of cognition through the *ability* channel is much stronger on advanced tasks than on routine tasks, whereas the indirect effect through self-efficacy plays a relatively more important role in decisions that involve less information processing. Thus, H2 is confirmed.

4.4. Reverse causality

The empirical evidence in the baseline analysis does not necessarily indicate the causal effects of cognitive abilities and self-efficacy on financial behavior. I discuss how I address the reverse causality issue below. First, I use generalized cognition and self-efficacy measures instead of measures related to financial management. The cognition score is not based on financial knowledge but rather is based on general memory, vocabulary, and numeracy skills. Thus, it is difficult to find examples that financial behavior changes general cognition abilities. I also use the self-efficacy score indicating people's belief in their ability to control and influence various aspects of their life in general. Unlike the financial self-efficacy measures, which measure respondents' self-assessed mastery in performing financial tasks, the generalized self-efficacy measure adopted in this paper is less prone to reverse causality bias.

Nevertheless, I follow Grinblatt, Keloharju and Linnainmaa (2011) and Kuhnen and Melzer (2018) and use lagged cognition and self-efficacy measures obtained four years before the financial behavior measures to rerun Equation (1). As shown in Column (4) of Table 2, the effects of the cognition score and self-efficacy on financial behavior remain significantly positive without substantial changes from the baseline results seen in Column (1) of Table 2.

To examine the influence of reverse causality bias on the estimated effect of cognitive abilities on self-efficacy, as described in Equation (2), I replace the cognition score in the current period with the cognition measure four years ago in Equation (2) and present the results in Column (2) of Table 4. The results indicate that the effect of cognitive abilities on self-efficacy is still statistically significant. Therefore, the main results in the baseline analysis are not driven primarily by reverse causality.

Table 5
Direct and Indirect Effects of Cognitive Abilities on Financial Behavior.

	(1). Financial behavior		(2).Routine tasks		(3). Advanced tasks	
Total effect	0.0110	***	0.0025	***	0.0085	***
	(0.0011)		(0.0006)		(0.0009)	
Direct effect	0.0097	***	0.0016	**	0.0081	***
	(0.0011)		(0.0006)		(0.0009)	
Indirect effect	0.0013	***	0.0009	***	0.0004	***
	(0.0002)		(0.0001)		(0.0001)	
Number of observations	9,182		9,182		9,182	
Number of clusters	4,927		4,927		4,927	
Log pseudolikelihood	−322465		−315508		−320759	

Note: This table reports estimated results from the structural equation model which simultaneously estimates the effect of cognitive abilities on self-efficacy, and the effects of cognitive abilities and self-efficacy on financial behavior. Direct effect indicates the effect of cognitive abilities on financial behavior. Indirect effect measures the effect of cognitive abilities on financial behavior through self-efficacy. Total effect is the sum of direct and indirect effects. Financial behavior score is based on six financial behavior indicators in column (1), three routine tasks in column (2) and three advanced tasks in column (3). Standard errors clustered at the household level are shown in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.5. Endogeneity bias

Endogeneity of cognitive abilities and self-efficacy could potentially lead to biased results in the baseline analysis. For example, omitted variables, such as individual ability and preference, could be correlated with the main explanatory variable, such as cognitive abilities or self-efficacy, thus biasing the estimates in OLS regressions. I adopt the instrumental variable approach to address the endogeneity issue. In particular, the HRS survey asked respondents how frequently they participated in activities, including playing cards and games, such as chess, and engaging in word games, such as crossword puzzles or Scrabble. It is assumed that active involvement in these activities could have a positive impact on one's cognition skills (Kazemi, Yektayar and Abad, 2011), but is not related to self-efficacy or financial behavior. Thus, involvement in card or word games is used as the instrumental variable for the cognition score. The instrumental variable for self-efficacy is based on the item in which respondents were asked to assess their control over their social life, which is expected to be related to their sense of self-efficacy in general, but not related to financial behavior.

I then use a two-stage least-squares (2SLS) estimator to examine the impacts of endogeneity on the main results in Equation (1). In the first-stage regressions, cognition and self-efficacy are significantly correlated with their instruments; minimum eigenvalue statistics are above the critical value to exclude the weak-instruments problem (Stock and Yogo, 2005). The estimates from the second-stage regression are shown in Column (5) of Table 2. The effects of cognitive abilities and self-efficacy on financial behavior remain robust.

The same procedure is applied to examine the endogeneity bias in estimating the effect of cognition on self-efficacy in Equation (2). In the first-stage regression, the instrument for cognition is statistically significant, and the *F*-statistic is above the critical value to reject the weak-instrument hypothesis (Stock, Wright and Yogo, 2002). Column (3) of Table 4 shows the second-stage estimates from 2SLS. The results indicate that the effect of cognitive abilities on self-efficacy remains statistically significant. Thus, the main results are not driven mainly by endogeneity of cognition or self-efficacy.

4.6. Omitted family background bias

Family background and other omitted time-invariant variables could be a potential source of estimation bias and deserve further investigation. I take advantage of the longitudinal dataset and adopt the first difference estimation method in Wooldridge (2010) to address the issue with time-invariant unobserved heterogeneity. Specifically, I calculate the intra-individual difference in financial behavior, self-efficacy, and cognition, along with other time-variant variables, and test the effect of cognition on self-efficacy and the effects of cognition and self-efficacy on financial behavior, using the following equations.

$$\Delta Efficacy_{i,t} = \alpha + \lambda_1 * \Delta Cog_{i,t} + \lambda_2 * \Delta \phi_{i,t} + \varepsilon_{i,t}. \quad (3)$$

$$\Delta Y_{i,t} = \alpha + \theta_1 * \Delta Cog_{i,t} + \theta_2 * \Delta efficacy_{i,t} + \theta_3 * \Delta \phi_{i,t} + \varepsilon_{i,t}, \quad (4)$$

Table 6
First Difference Estimation.

	(1). Effect of cognition on self-efficacy		(2). Effects of cognition and self-efficacy on financial behavior	
Δcognition score	0.0770	**	0.0034	*
	(0.0239)		(0.0016)	
Δself-efficacy			0.0032	**
			(0.0010)	
Δmarital status	1.1734		0.1476	*
	(0.8651)		(0.0589)	
Δhousehold income	0.0013		0.0003	
	(0.0023)		(0.0002)	
Δpoverty status	−1.1383		−0.1590	*
	(1.0095)		(0.0687)	
Δhousehold wealth	0.0009	*	0.0002	***
	(0.0003)		(0.00002)	
Δhome ownership	4.0040	***	0.0221	
	(0.9425)		(0.0643)	
Δmortgage status	−1.7769	*	−0.0368	
	(0.7636)		(0.0520)	
Δemployment status	−0.3934		0.0863	
	(1.2486)		(0.0850)	
Δretirement status	−1.3082		0.0325	
	(1.1448)		(0.0779)	
Number of observations	4,975		4,975	
R-Square	0.0095		0.0222	

Note: This table reports results from first difference estimation. Column (1) reports the effects of cognitive abilities on self-efficacy. Column (2) reports the effects of cognitive abilities and self-efficacy on financial behavior. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

where $\Delta Y_{i,t}$, $\Delta Efficacy_{i,t} and \Delta Cog_{i,t}$ are the changes in financial behavior, self-efficacy, and cognition in year t from four or eight years ago of individual i . $\Delta\phi_{i,t}$ are the changes in time-variant control variables, such as marital status, income, poverty status, wealth, home ownership, mortgage status, employment, and retirement status. The first difference estimation is expected to eliminate unobserved time-invariant variables like family background, childhood experience, cultural influence, and other stable personality characteristics. As shown in Column (1) of Table 6, the positive effect of cognition on self-efficacy remains statistically significant. A one-unit decrease in an individual's cognition score change leads to a 0.08 decrease in self-efficacy change. The results in Column (2) of Table 6 confirm the effects of cognition and self-efficacy on financial behavior. An increase in cognition and self-efficacy change will both lead to a higher financial behavior score change. Thus, after controlling for the effects of time-invariant unobserved heterogeneity, the effect of cognition on self-efficacy and the effects of cognition and self-efficacy on financial behavior remain statistically significant.

5. Conclusions and implications

This paper investigates the effect of cognitive abilities on financial behavior among older adults. Using the longitudinal dataset of the HRS, this study finds that cognitive abilities significantly affect financial behavior through both the *ability* and *self-efficacy* channels. People with higher cognition scores, who presumably are more capable of processing information and analyzing problems, achieve better financial outcomes. The positive association between the cognition score and financial behavior is especially strong among advanced tasks that demand more cognitive skills, which confirms the existence of the *ability* channel of the cognitive ability effect. In addition, I find evidence of the secondary source of cognitive influence—self-efficacy. Cognition is shown to have a positive effect on self-efficacy, which also significantly affects financial behavior.

These findings have several important implications. First, they call for greater efforts to assist the older population through the cognitive aging process. On the one hand, the rapidly growing older population is taking greater responsibility for managing a substantial portion of financial wealth in the United States. On the other hand, as pointed out by this paper, the widespread cognitive ability deterioration among the older adults makes them more vulnerable to financial management inefficiency. It urges the policymakers and financial service providers to provide more regulatory protections and effective service programs to the older population.

Moreover, this study highlights the noncognitive source of influence on financial behavior induced by cognitive difference—self-efficacy. Previous studies on cognitive effects on financial behavior have focused on financial capability deterioration; thus, policy options to address the identified problems are mainly on financial education and outsourcing financial decisions to professional financial advisors (Agarwal et al., 2009; Gamble et al., 2015; Finke, Howe and Huston, 2017). This paper indicates that self-efficacy could be another source of intervention. Indeed, I find evidence that self-efficacy effectively improves financial outcomes; especially among routine tasks that do not require many cognitive skills, improving one's self-belief in his or her ability can influence financial outcomes to a larger extent than can simply improving cognitive skills. In addition, it might be challenging to intervene in the process of cognitive deterioration—the consequence of biological aging; noncognitive skills, however, could potentially be improved by effective interventions. Thus, educational programs and professional advisory services should be offered along with efforts to build individuals' noncognitive skills, such as self-efficacy, for the best outcomes.

Finally, in an effort to improve people's quality of life after retirement, this paper points out that cognitive aging process could negatively affect their life to a larger extent than merely causing performance loss in tasks that require cognitive abilities. By affecting people's belief in their abilities, many aspects of their life could be negatively affected. Thus, helping the dramatically growing older population face cognitive aging should involve a broader set of considerations such as improving noncognitive skills than simply a focus on ability improvement.

Declaration of Competing Interest

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

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None.

Appendix A. Survey questions

Financial behavior–routine tasks

1. How difficult is it for (you/your family) to meet monthly payments on (your/your family's) bills? (1. not at all difficult; 2. not very difficult; 3. somewhat difficult; 4. very difficult; 5. completely difficult)

   Constructed indicator = 1 if respondent answered 1 or 2; indicator = 0 if respondent answered 3, or 4, or 5.

2. Since last wave/In the last two years, have you always had enough money to buy the food you need? (1. Yes; 5. No)

Constructed indicator = 1 if respondent answered 1; indicator = 0 if respondent answered 5.

3. Have you fallen more than 2 months behind on mortgage payments in the past 2 years? (1. Yes; 5. No)

Constructed indicator = 1 if respondent answered 5; indicator = 0 if respondent answered 1.

Financial behavior–advanced tasks

1. How closely do you follow the stock market: very closely, somewhat, or not at all? (1. very closely; 2. somewhat closely; 3. not at all)

Constructed indicator = 1 if respondent answered 1 or 2; indicator = 0 if respondent answered 3.

2. Diversification indicator is constructed by the author based on questions asking if respondents or their spouse or partner owned stock, stock mutual funds, checking or savings accounts, money market funds, CDs, government savings bonds, treasury bills, corporate, municipal, government or foreign bonds, and bond funds.
3. Financial wealth growth indicator is constructed by the author by calculating the growth rate of the financial wealth listed in question 2. Then the growth rates are compared with the median growth rate within the respondent's age groups.

Self-efficacy

Please say how much you agree or disagree with each of the following statements. (1. strongly disagree; 2. somewhat disagree; 3. slightly disagree; 4. slightly agree; 5. somewhat agree; 6. strongly agree)

1. I often feel helpless in dealing with the problems of life.
2. Other people determine most of what I can and cannot do.
3. What happens in my life is often beyond my control.
4. I have little control over the things that happen to me.
5. There is really no way I can solve the problems I have.
6. I can do just about anything I really set my mind to.
7. When I really want to do something, I usually find a way to succeed at it.
8. Whether or not I am able to get what I want is in my own hands.
9. What happens to me in the future mostly depends on me.
10. I can do the things that I want to do.

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