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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 longitudinal dataset of the 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, who presumably are more capable of processing information and analyzing problems, achieve better financial outcomes. This positive association is especially strong in tasks having high demand of cognitive ability, 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 belief in their capacity to control and influence their life, and lower self-efficacy significantly decreases financial management efficiency. The results from various robustness tests exclude the possibility that the main results are driven primarily by reverse causality, endogeneity, family background or sample selection bias. 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.

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1. Introduction

The older population in the United States has increased dramatically, and more than 20% of the overall U.S. population is predicted to be aged 65 and older by the year 2030 (Johnson, 2020). This older population needs to make influential financial decisions with a substantial amount of wealth accumulated throughout the lifetime. Worse financial outcomes, such as greater indebtedness, credit transaction errors, and investment decisions that lead to weak performance, however, have been observed as people age (Agarwal et al., 2009; Korniotis and Kumar, 2011; Lusardi et al., 2019). The efficiency of the financial behavior of the older population not only determines their well-being in the last period of their lives but also has wide-ranging implications on society (Agarwal and Mazumder, 2013). Yet, despite the growing salience of the issue, our understanding of factors that contribute to financial behavior among older adults is limited. This paper focuses on the role of cognitive abilities in determining financial behavior among older adults.

Cognitive abilities can influence financial behavior among older adults 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 commonly measured by memory, numeracy and vocabulary tests 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 one's belief in his or her ability to control and influence various aspects of life, namely, self-efficacy. In this secondary *self-efficacy* channel, 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 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 longitudinal data from the U.S. Health and Retirement Study (HRS), a nationally representative study of Americans over age 50, 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 well-established measures of cognition and self-efficacy, which are scarce in existing datasets. 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 (whether the household always has enough money to buy the food needed, preventing financial constraints, 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 exerts a positive effect on self-efficacy, which also significantly affects 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, leads to lower 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 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 variables that may confound the effects of cognitive abilities. 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, unlike previous studies that adopted proxies like age and education to examine cognitive effects, this paper uses direct measures of cognition 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. Most 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, probably due to a lack of data or potential identification problems (Grinblatt et al., 2011; Gamble et al., 2015). This paper not only confirms the significant influence of cognition on older adults'

financial behavior but also shows 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. Although a wide range of psychological traits 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 as older adults experience cognitive aging.

Finally, by highlighting the roles of evolving cognitive abilities and self-efficacy in financial behavior in the older population, this study contributes to the literature on financial management after retirement. Acknowledging the widespread inefficiency in financial management among older adults, a growing number of studies investigate ways to help them improve. The main focus has been on educational programs, professional advisory services, and helpful nudges targeted at mitigating the negative impacts of deteriorating cognitive abilities (Agarwal et al., 2009; Finke et al., 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, and Section 5 provides policy implications. A conclusion is offered in Section 6.

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 et al., 2010; Grinblatt et al., 2011). Bruine de Bruin et al. (2012) also points out that decreased fluid cognitive ability in old age 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 et al., 2010). 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 confirmed.

H2: The effect of cognitive abilities on financial behavior is stronger in decisions demanding more information processing and analytical ability.

A small but growing body of research has investigated and confirmed the effect of cognitive abilities on financial behavior in credit transactions, investments, portfolio choice, and stock market participation (e.g., Agarwal et al., 2009; Christelis et al., 2010; Grinblatt et al., 2011; Korniotis and Kumar, 2011). They are, however, limited in the following ways. First, due to the limitations of the data, few studies used direct measures of cognition. Instead, the link between age and quality of financial decision making was used to imply the effect of cognitive aging. Estimated results from this approach are open to alternative interpretations, such as birth cohort effects (Agarwal et al., 2009).[1] Second, most studies focused only on financial behavior in one area without testing the varying cognitive effects on financial behavior with different degrees of dependence on cognition. Thus, a test of the *ability* channel as summarized in hypothesis H2 cannot be implemented. Finally, few studies have attempted to explain the mechanism that drives the association between cognitive abilities and financial behavior. This study addresses the gaps in the literature by adopting a direct measure of cognition to investigate its impact on various financial behaviors, ranging from routine to advanced tasks, and explaining the channels through which such effects occur.

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; Asebedo and Payne, 2019). "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, 1977). 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

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[1]   A few studies used direct measure of cognition. For example, Finke et al. (2017) and Gamble et al. (2015) included cognition scores in their studies to investigate the cognitive aging effects on financial knowledge. Christelis et al. (2010) used three indicators of cognitive abilities in SHARE dataset based on European countries to study the relationship between cognitive abilities and stockholding. Grinblatt et al. (2011) used the Finnish Armed Forces intelligence assessment to explore the effects of IQ on stock market participation.

of self-efficacy (Bandura 1977; Lippke, 2017). 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). All of these skills and qualities play a critical role in achieving optimal financial behavior. Nevertheless, research on the effect of self-efficacy on financial behavior is limited. Among the few studies that empirically test the link between self-efficacy and financial behavior, Farrell et al. (2016) show a relationship between self-efficacy and the choice of financial products among women. Chatterjee et al. (2011) find that self-efficacy predicts financial market participation and wealth accumulation. Kuhnen and Melzer (2018) provide evidence that people with high levels of self-efficacy are more likely to take precautionary actions and consequently prevent financial distress. None of these studies, however, investigated the interplay of cognitive abilities and self-efficacy in determining financial behavior. This study extends the previous literature by investigating how cognitive abilities affect a wide range of financial behaviors through self-efficacy. It also adds to this line of research by carefully addressing potential identification issues of reverse causality, endogeneity, and family background bias.

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

3. Data

3.1. Data and sample selection

This study uses the longitudinal dataset provided by HRS, a nationally representative multi-disciplinary study of Americans over age 50 (Sonnega et al., 2014). The dataset contains information on economic, health, marital, and family status as well as pensions and other support systems of older Americans (Health and Retirement Study, 2019). More importantly, it contains well-established measures of cognition and self-efficacy. This paper combines HRS surveys in areas of cognition, psychosocial characteristics, and financial behavior. Specifically, the selected sample is derived from eight files: (1) Cognition file that records respondents' cognition test scores; (2) Psychosocial and lifestyle (leave-behind) file that provides measures of respondents' self-efficacy, risk preference, financial strain, as well as activity participation; (3) RAND HRS files that include detailed income and wealth data; (4) HRS Tracker file that contains demographic information, such as gender, ethnicity, education attainment, age, and marital status; (5) Employment file on employment and retirement status; (6) Expectations file that contains variables in regard to how closely an individual follows the stock market; (7) Assets and Income file that provides information on whether the household had enough money to buy needed food; and (8) Housing file on mortgage payments. I use the HRS surveys during the period of 2008–2016. All of the surveys adopted by this study take place every two years, except for the Psychosocial and Lifestyle Questionnaire, which 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).[2] I keep respondents with data on main variables and covariates and derive a selected sample of 12,750 observations. I describe the major measures next.

3.1.1. Financial behavior

I create six indicators of financial behavior: whether the household had a financial strain in meeting monthly payments; whether the household always had enough

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[2] The full sample is divided into two random samples, for which each completes the Psychosocial and Lifestyle Questionnaire on a rotating basis. Therefore, the first subsample completed the survey in 2008, 2012, and 2016, and the second subsample completed the survey in 2010 and 2014 (Smith et al., 2017; Asebedo and Payne, 2019).

money to buy the food needed in the past two years; whether the household fell more than two months behind on mortgage payments; whether the household held more than one type of financial asset for portfolio diversification; whether the respondent closely followed the stock market; and 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. Although other financial behavior measures are available, I select these six indicators based on two criteria. First, 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 financial outcome measure 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 confounded estimates.

Second, I include only measures that are less prone to the impacts of lifecycle changes in financial management or other unobserved age-driven variables. For example, I do not include stock participation in the analysis. Older respondents may choose not to invest in stocks because they need to shift away from risky assets as they age rather than due to cognitive abilities or self-efficacy that may decline with age as well. Excluding such behavior measures mitigates the omitted variable bias which could lead to a spurious relationship between financial behavior and cognition or self-efficacy. 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. 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" have a higher demand for information processing and analytical ability than "routine tasks." See the appendix for the survey questions.

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 7s, 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 self-efficacy questions that focus on a personal sense of control, in general. 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.

3.2. Summary statistics

Summary statistics on all measures as well as covariates are shown in Table 1. The average financial behavior score is 4.23 out of 6. Respondents score higher in routine tasks with a mean of 2.74 out of 3 and lower in advanced tasks with a mean of 1.49 out of 3. The scaled cognition score has a mean of 64.43 out of 100, and the self-efficacy score has a mean of 76.93 out of 100.

The sample includes adults aged 50–104, and males comprise 40.5% of the sample. The breakdown of ethnicities is White (86.85%), Black or African American (9.84%), and other (3.32%). Of the respondents, 60.31% are married. Respondents have a mean of 13.11 years of education. The average household income is $63,321, and the household net wealth is $594,755. The respondents have a mean risk-preference level of 2.80 out of 10 (0-unwilling to take any risks in financial matters; 10-fully prepared to take risks). Of the respondents, 84.88% own their house, 17.36% are still employed, and 73.07% have retired. As for residence region, 14.38% live in the Northeast; 27.64% in the Midwest; 39.18% in the South; 18.74% in the West; and 0.07% in other areas.

Table 1. Summary statistics

	Obs.	Mean	SD	Min	Max
Dependent Variables					
Financial behavior	12,750	4.23	1.20	0	6
Routine tasks	12,750	2.74	0.51	0	3
Advanced tasks	12,750	1.49	0.97	0	3
Independent Variables					
Cognition score	12,750	64.43	12.55	2.86	100
Self-efficacy score	12,750	76.93	18.43	0	100
Covariates					
Age	12,750	74.54	6.63	50	104
Male	12,750	40.50%	49.09%	0	1
Race	12,750				
White	12,750	86.85%	33.80%	0	1
Black or African American	12,750	9.84%	29.78%	0	1
Other	12,750	3.32%	17.91%	0	1
Married	12,750	60.31%	48.93%	0	1
Years of school	12,750	13.11	2.70	0	17
Household income	12,750	$63,321	$93,450	0	$3,010,980
Household wealth	12,750	$594,755	$1,084,283	-$1,495,000	$30,850,000
Home owner (yes=1, no=0)	12,750	84.88%	35.83%	0	1
Risk preference	12,750	2.80	2.58	0	10
Employed (1=yes, 0=no)	12,750	17.36%	37.88%	0	1
Retired (1=yes, 0=no)	12,750	73.07%	44.36%	0	1
Residence region	12,750				
Northeast	12,750	14.38%	35.09%	0	1
Midwest	12,750	27.64%	44.72%	0	1
South	12,750	39.18%	48.82%	0	1
West	12,750	18.74%	39.02%	0	1
Other region	12,750	0.07%	2.66%	0	1

Note: Statistics of financial behavior score, cognition score, self-efficacy score and other covariates among respondents in the selected sample.

Figure 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).[3] 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, 2019).

[3] The method of "controlled analysis" is defined by Agarwal et al. (2009) as follows: first calculate the average rate of performance change between adjacent survey waves for all respondents straddling at age a: $\frac{1}{N_{\Omega(a)}} \sum_{i \in \Omega(a)} \frac{x_{i,w+1} - x_{i,w}}{A_{i,w+1} - A_{i,w}}$, where $x_{i,w}$ is the performance of individual i in HRS wave w, $A_{i,w}$ is the age of individual i in wave w, $\Omega(a)$ is the set of respondents with performance measures in two adjacent waves at ages that straddle age 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 cognition questions were asked among those who were aged 65+ or had never been interviewed before, the analysis ends up with respondents aged 65+, while the selected sample covers respondents aged 50+.

Figure 1. Financial behavior, cognitive abilities and self-efficacy by age

A. Financial behavior and age

B. Cognition and age

C. Self-efficacy and age
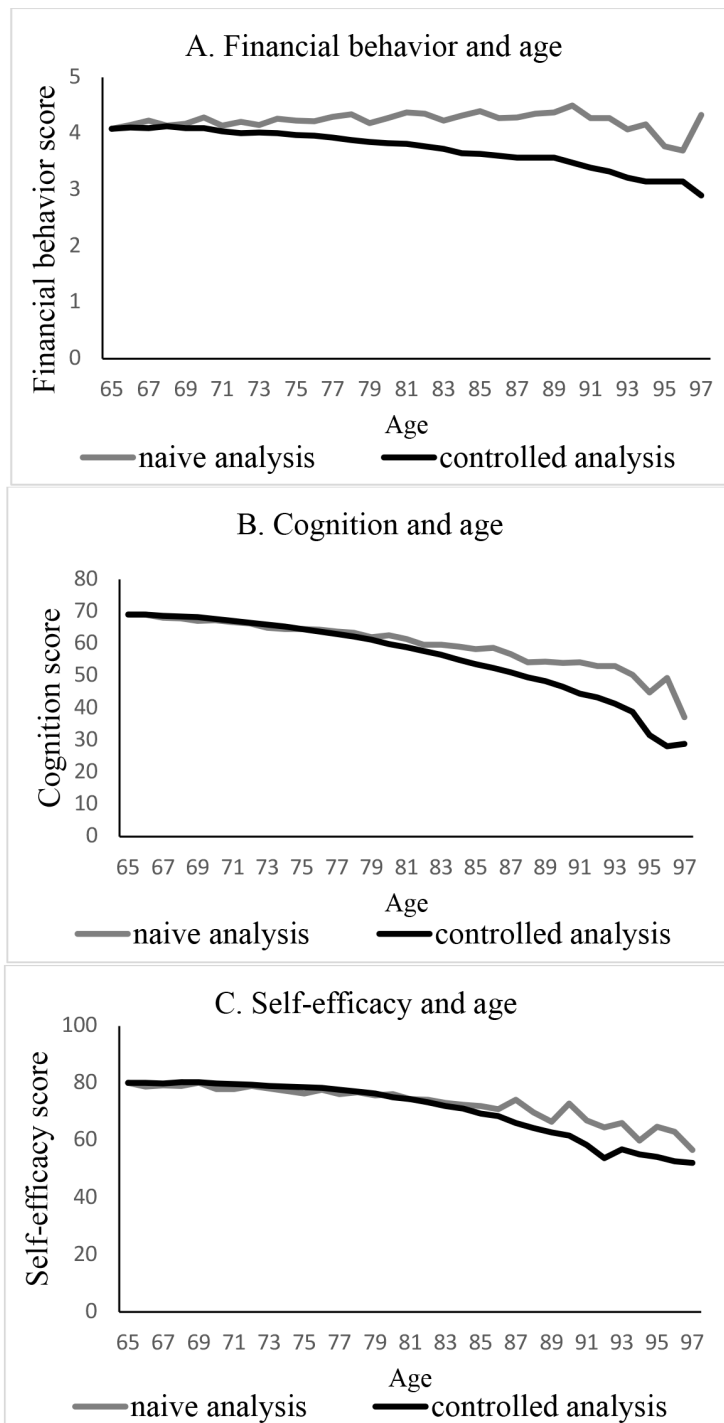
Note: This figure illustrates the age pattern of financial behavior (Panel A), cognition (Panel B) and self-efficacy (Panel C). Naïve analysis plots mean financial behavior, cognition, or self-efficacy by age. Controlled analysis uses intra-individual differences in adjacent waves to track the age pattern of performance.

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, household wealth, home ownership, 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 (12.55) increase in cognitive score leads to a 0.12 increase in the financial behavior score. To quantify the importance of 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 $46,000 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. The results are consistent with previous studies (e.g., Christelis et al., 2010; Finke et al., 2017). H1 is confirmed.

Table 2. Effects of cognitive abilities and self-efficacy on financial behavior

	(1). Financial behavior	(2). Routine tasks	(3). Advanced tasks	(4). Financial behavior–lagged cognition and self-efficacy	(5). Financial behavior–IV analysis
Cognition score	0.0092***	0.0018***	0.0074***		0.0234***
	(0.0010)	(0.0005)	(0.0008)		(0.0088)
Self-efficacy	0.0071***	0.0048***	0.0023***		0.0088***
	(0.0006)	(0.0003)	(0.0005)		(0.0015)
Lag cognition				0.0094***	
				(0.0013)	
Lag self-efficacy				0.0063***	
				(0.0007)	
Age	0.0220***	0.0113***	0.0107***	0.0192***	0.0297***
	(0.0020)	(0.0009)	(0.0017)	(0.0026)	(0.0044)
Male	0.1354***	0.0119	0.1235***	0.1346***	0.1729***
	(0.0201)	(0.0094)	(0.0168)	(0.0246)	(0.0351)
Race (ref: other)					
White	0.0536	0.0030	0.0506	0.0438	0.0206
	(0.0659)	(0.0329)	(0.0501)	(0.0879)	(0.0794)
Black or African American	-0.3539***	-0.1360***	-0.2179***	-0.3724***	-0.2937***
	(0.0735)	(0.0389)	(0.0561)	(0.0971)	(0.0783)

Table 2. Effects of cognitive abilities and self-efficacy on financial behavior (continued)

	(1). Financial behavior	(2). Routine tasks	(3). Advanced tasks	(4). Financial behavior–lagged cognition and self-efficacy	(5). Financial behavior–IV analysis
Married	0.1296***	0.0594***	0.0703***	0.1257***	0.1333***
	(0.0276)	(0.0126)	(0.0225)	(0.0321)	(0.0284)
Years of education	0.0639***	0.0135***	0.0504***	0.0650***	0.0402***
	(0.0054)	(0.0024)	(0.0043)	(0.0064)	(0.0143)
Household income (in $1000)	0.0005***	0.0002***	0.0003***	0.0006**	0.0004***
	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Household wealth (in $1000)	0.0002***	0.0001***	0.0002***	0.0002***	0.0002***
	(0.00003)	(0.00001)	(0.00003)	(0.00004)	(0.00003)
Home owner (yes=1, no=0)	0.3198***	0.1123***	0.2075***	0.2709***	0.2893***
	(0.0352)	(0.0182)	(0.0277)	(0.0416)	(0.0388)
Risk preference	0.0342***	-0.0013	0.0355***	0.0381***	0.0337***
	(0.0047)	(0.0022)	(0.0038)	(0.0055)	(0.0048)
Employed (1=yes, 0=no)	0.0271	0.0693***	-0.0422	-0.0560	-0.0200
	(0.0439)	(0.0216)	(0.0353)	(0.0566)	(0.0487)
Retired (1=yes, 0=no)	0.1461***	0.0810***	0.0651**	0.0963**	0.1161***
	(0.0378)	(0.0190)	(0.0294)	(0.0462)	(0.0411)
Residence region fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Number of observations	12,750	12,750	12,750	8,235	12,332
Number of clusters	5,280	5,280	5,280	3,948	5,204
R-Square	0.2320	0.1197	0.1898	0.2330	0.2127
First-stage minimum eigenvalue statistic					97.3826
F-statistic for endogeneity tests					6.4078

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 column (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). Column (1), (2) and (3) report estimated results from OLS regressions. Main explanatory variables are cognition score and self-efficacy score measured in the same period as financial behavior. Column (4) reports estimated result from OLS regression by using lagged 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. It uses the variable indicating individual involvement in card games or word games as instrument for cognition score and uses the variable indicating respondents' self-belief in their control over social life as instrument for self-efficacy. Standard errors clustered at the household level are shown in parentheses.

*, **, *** denote 10%, 5%, 1% significance levels, respectively.

The results in Column (1) of Table 2 also show that self-efficacy positively affects financial behavior, and the effect is statistically significant at 1% level. The effects of other controls are consistent with the literature. For example, older age; being married and male; and having higher educational attainment, income, and wealth are associated with better financial performance (Calvet et al., 2007, 2009; Lusardi and Mitchell, 2014).

4.2 Ability channel

The cognition measure based on 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 influence on financial behavior through the *ability* channel, the effects are expected to be stronger among advanced tasks which require more cognitive skills (Christelis et al., 2010). 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 (0.0018 in Column (2) on routine tasks vs. 0.0074 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 effect of cognition is not primarily driven by its correlation with self-efficacy and other control variables, but cognitive abilities could drive many of these variables (Grinblatt et al., 2011). Hence, there could be secondary channels through which cognitive

abilities influence financial behavior. For example, as summarized in Section 2, there are plausible reasons to expect that high-cognition individuals are more likely to believe in their abilities to influence their future, which, in turn leads to better financial behavior.

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). Granblatt et al. (2011) employ 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 4.57, and those with the bottom centile of cognition score, with a mean financial behavior score of 3.66. Then, the Blinder-Oaxaca decomposition method is employed to explore how much of the difference in financial behavior (0.91) 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 and other control variables can explain more than 76% of the difference in financial behavior between low- and high-cognition groups. In particular, the difference in self-efficacy between the two groups accounts for a 12% difference in financial behavior, holding other control variables fixed. For comparison, difference in wealth explains 15% of the outcome differences, and other control variables, such as risk preference, have far 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 among respondents with cognition scores in the lowest and highest quartiles.

Table 3. Blinder-Oaxaca decompositions of the secondary channels of cognitive ability effects on financial behavior

	(1). Top vs. bottom centile	(2). Top vs. bottom quartile
Self-efficacy	0.1106***	0.0725***
	(0.0172)	(0.0081)
Years of education	0.3042***	0.1982***
	(0.0351)	(0.0170)
Household income (in $1000)	0.0063	0.0159**
	(0.0170)	(0.0076)
Household wealth (in $1000)	0.1357***	0.0841***
	(0.0259)	(0.0154)
Home owner (yes=1, no=0)	0.0680***	0.0437***
	(0.0135)	(0.0061)
Risk preference	0.0203***	0.0132***
	(0.0071)	(0.0036)
Demographics	0.0593*	0.0032
	(0.0317)	(0.0144)
Employment	-0.0132	-0.0074
	(0.0129)	(0.0053)
Financial behavior score of higher cognition group	4.5718	4.5155
Financial behavior score of lower cognition group	3.6646	3.8941
Difference between groups	0.9073	0.6214
Explained difference	0.6913	0.4235
Unexplained difference	0.2159	0.1979

Note: This table reports results from Blinder-Oaxaca Decompositions. The analysis measures how much of the difference in financial behavior score between individuals with high- and low-cognition scores can be explained by differences in control variables such as self-efficacy, education, household income, household wealth, home ownership, risk preference, employment status, and demographics including age, gender, marital status and race. 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.

*, **, *** denote 10%, 5%, 1% significance levels, respectively.

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 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 0.19-unit increase in self-efficacy. In addition, the results confirm that individual self-efficacy declines with age. Being male; having higher educational attainment, income, and wealth; and being employed are all associated with higher self-efficacy, which is consistent with the literature (Heckman et al., 2006; Chatterjee et al., 2011).

Table 4. Effect of cognitive abilities on self-efficacy

	(1). Baseline analysis	(2). Lag cognition	(3). IV analysis
Cognition score	0.1880***		0.8770***
	(0.0176)		(0.1435)
Lag cognition score		0.1584***	
		(0.0222)	
Age	-0.2232***	-0.3633***	0.1138
	(0.0341)	(0.0431)	(0.0791)
Male	1.6322***	2.0467***	3.7339***
	(0.4204)	(0.4827)	(0.6246)
Race (ref: other)			
White	1.3913	2.0002	-1.6702
	(1.1405)	(1.3997)	(1.3921)
Black or African American	3.4314***	3.5178**	5.0113***
	(1.2668)	(1.5434)	(1.3937)
Married	-1.4964***	-1.5453***	-1.7460***
	(0.4494)	(0.5127)	(0.4863)
Years of education	0.4382***	0.5124***	-0.6374***
	(0.0849)	(0.0969)	(0.2390)
Household income (in $1000)	0.0073***	0.0078***	0.0042**
	(0.0018)	(0.0027)	(0.0020)
Household wealth (in $1000)	0.0010***	0.0010***	0.0008***
	(0.0002)	(0.0002)	(0.0002)
Home owner (yes=1, no=0)	2.6165***	2.0916***	1.4834**
	(0.6001)	(0.6633)	(0.6880)
Risk preference	0.1737**	0.1899**	0.1488*
	(0.0813)	(0.0942)	(0.0891)
Employed (1=yes, 0=no)	3.0283***	3.0243***	1.3813
	(0.7756)	(0.9558)	(0.9223)
Retired (1=yes, 0=no)	1.4565**	0.9244	0.5242
	(0.6806)	(0.7895)	(0.7886)
Residence region fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Number of observations	12,750	8,786	12,460
Number of clusters	5,280	4,271	5,229
R-Square	0.0733	0.0714	
First-stage F-statistic			171.37
F-statistic for endogeneity tests			27.3609

Note: This table reports the effect of cognitive abilities on self-efficacy. Dependent variable is individual self-efficacy score. Column (1) reports estimated results from OLS regression. Main explanatory variable is cognition score measured in the same period as self-efficacy. Column (2) reports estimated results from OLS regression by using lagged 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. It uses the variable indicating individual involvement in card or word games as instrument for cognition score. Standard errors clustered at the household level are shown in parentheses.

*, **, *** denote 10%, 5%, 1% significance levels, respectively.

In the next step, 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 (18.43) in self-efficacy leads to a 0.13 increase in financial behavior, whereas a one-standard-deviation (12.55) 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. 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 at 1% level, as shown in Column (1) of Table 5. 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, H1–H3 are confirmed.

Table 5. Direct and indirect effects of cognitive abilities on financial behavior

	(1). Financial behavior	(2). Routine tasks	(3). Advanced tasks
Total effect	0.0105***	0.0027***	0.0078***
	(0.0010)	(0.0005)	(0.0008)
Direct effect	0.0092***	0.0018***	0.0074***
	(0.0010)	(0.0005)	(0.0008)
Indirect effect	0.0013***	0.0009***	0.0004***
	(0.0002)	(0.0001)	(0.0001)
Number of observations	12,750	12,750	12,750
Number of clusters	5,280	5,280	5,280
Log pseudolikelihood	-440187	-430168	-437868

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.

*, **, *** denote 10%, 5%, 1% significance levels, respectively.

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. For example, the positive relationship between self-efficacy and financial behavior could be driven by the fact that good financial outcomes boost one's self-efficacy, not the other way around. Below, I discuss how I address the reverse causality issue.

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 one's financial behavior changes his or her general cognition abilities. I also use the self-efficacy score to measure people's belief in their ability to control and influence various aspects of their life in general. Unlike the "financial self-efficacy" measure employed in previous studies, which concerns respondents' self-assessed mastery in performing financial tasks, the generalized self-efficacy measure adopted in this paper is less prone to reverse causality bias (Farrell et al., 2016; Asebedo and Payne, 2019).

Nevertheless, I follow Grinblatt et al. (2011) and Kuhnen and Melzer (2018) in using lagged cognition and self-efficacy measures to evaluate the influence of reverse causality bias on the main results. In particular, lagged cognition and self-efficacy measures obtained four years before the financial behavior measures are adopted 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.

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 et al., 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 omitted variables that affect 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 correlated with their instruments at 1% significance level; 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 recommended by Stock et al. (2002) to reject the weak-instrument hypothesis. 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. For example, it is possible that parents who invest more in their children's education and character formation are also more likely to share financial knowledge and provide financial support for their offspring, which could lead to a spurious relationship among financial behavior, cognition, and self-efficacy (Grintlatt et al., 2011; Kuhnen and Meizer, 2018). 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.

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

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

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. $\Delta\phi_{i,t}$ is the change in time-variant control variables, such as marital status, income, wealth, home ownership, 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 leads to a 0.12 decrease in self-efficacy. 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 will both lead to a higher financial behavior score. 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.

Table 6. First difference estimation

	(1). Effect of cognition on self-efficacy	(2). Effects of cognition and self-efficacy on financial behavior
Δ cognition score	0.1218***	0.0031*
	(0.0282)	(0.0016)
Δ self-efficacy		0.0024**
		(0.0010)
Δ marital status	0.2144	0.0928
	(0.9523)	(0.0569)
Δ household income	0.0019	0.0004**
	(0.0018)	(0.0002)
Δ household wealth	0.0008**	0.0002***
	(0.0003)	(0.00003)
Δ home ownership	3.0455***	0.0093
	(1.1372)	(0.0729)
Δ employment status	0.6577	0.1278*
	(1.2202)	(0.0734)
Δ retirement status	-1.1052	0.0571
	(1.0453)	(0.0606)
Number of observations	4,637	4,637
Number of clusters	3,651	3,651
R-Square	0.0110	0.0174

Note: This table reports results from first difference estimation. Column (1) reports the effects of cognitive abilities on self-efficacy. Dependent variable is the change in self-efficacy from four or eight years ago of the same individual. Explanatory variables are intra-individual differences in cognition score and other time-variant variables between current year and four or eight years ago. Column (2) reports the effects of cognitive abilities and self-efficacy on financial behavior. Dependent variable is the change in financial behavior from four or eight years ago of the same individual. Explanatory variables include intra-individual difference in cognition scores, self-efficacy and other time-variant variables between current year and four or eight years ago. Standard errors clustered at the household level are shown in parentheses.

*, **, *** denote 10%, 5%, 1% significance levels, respectively.

4.7. Results from financial respondent subsample

In the selected sample, some households have more than one respondent, and some financial behavior questions were taken at the household level. It is possible that some respondents in the sample are not the financial decision makers of the household. To address this issue, I construct a subsample of "financial respondents" who answered household-level financial questions and presumably participated in household financial decisions. I rerun Equations (1) and (2) in the baseline analysis using the subsample. The results in Table 7 indicate no significant changes from results in baseline analysis. I also rerun the robustness checks, as discussed in Sections 4.4–4.6 for the financial respondents subsample, and the main results remain robust.[4]

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[4]   The results are not reported in the paper but are available on request.

Table 7. Subsample analysis–Financial respondents

	(1). Financial behavior	(2). Routine tasks	(3). Advanced tasks	(4). Self-efficacy
Cognition score	0.0097***	0.0016***	0.0081***	0.1715***
	(0.0010)	(0.0005)	(0.0009)	(0.0174)
Self-efficacy	0.0076***	0.0052***	0.0024***	
	(0.0006)	(0.0003)	(0.0005)	
Residence region fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Number of observations	9,206	9,206	9,206	9,206
R-Square	0.2518	0.1297	0.2093	0.0734

Note: This table reports OLS estimates using a subsample of financial respondents. Dependent variable is financial behavior score based on six financial behavior indicators in column (1), financial behavior score based on three routine tasks in column (2), financial behavior score based on three advanced tasks in column (3) and self-efficacy in column (4). Main explanatory variables are cognition score and self-efficacy score in columns (1)-(3), and cognition score in column (4). All four regressions control for age, gender, race, marital status, years of education, household income, household wealth, home ownership, risk preference, employment and retirement status (results not reported in the table). Standard errors clustered at the household level are shown in parentheses.

*, **, *** denote 10%, 5%, 1% significance levels, respectively.

5. Policy implications

The findings in this paper 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 amount of wealth that has accumulated over the lifetime while facing progressively more complex financial markets and products. On the other hand, as pointed out by this paper, they are experiencing inevitable cognitive ability deterioration, which makes them more vulnerable to financial management inefficiency. Unfortunately, older adults lack the flexibility in the labor market to compensate for the financial mistakes, and most retirees have fewer regulatory protections than do workers (Agarwal et al., 2009).

Among the few studies that investigate cognitive decline and its impact on older adults' financial decision making, the focus has been 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 et al., 2017). The findings in this paper indicate the noncognitive source of influence induced by cognitive decline—self-efficacy. Older people may suffer from worse financial outcomes not only due to deteriorating cognitive abilities but also because they lose belief in their abilities and, therefore, stop making an effort to manage their finances. As suggested by the findings in this paper, self-efficacy effectively improves financial outcomes. Especially among routine tasks that do not require many cognitive skills, improving one's self-efficacy can influence financial outcomes to a larger extent than can simply improving cognitive skills. Thus, efforts need to be made by policymakers and financial advisors to enhance older adults' belief in their abilities, which can motivate them to take action to improve their financial situation. Educational programs and professional advisory service, complemented by efforts to build individuals' noncognitive skills, such as self-efficacy, can lead to more effective outcomes.

Finally, due to the dramatic growth in the proportion of older people, there has been heightened interest in improving their quality of life after retirement. Results in this paper point out that cognitive aging, a normal and inevitable consequence of biological aging, could not only lead to performance loss in tasks that require

cognitive capacity, but also negatively affects people's belief in their ability to influence various aspects of life. Thus, helping people face cognitive aging should involve a broader set of elements than simply a focus on ability improvement.

6. Conclusions

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. In this study, I carefully address the identification issues and exclude the possibility that the main results are driven primarily by reverse causality, endogeneity, family background and sample selection bias.

These findings warrant a focus on the older population in policy designs to improve household financial well-being. Given the inevitable cognitive aging process and the significant role it plays in determining financial outcomes, older adults are especially vulnerable to financial mistakes. Policymakers are urged to make a greater effort to assist the older population through the cognitive aging process. This study also highlights that, with a decline in cognitive ability, older adults not only suffer financially, but also experience declining noncognitive skills. By losing the belief in their abilities, many aspects of their life could be negatively affected. Thus noncognitive skills among older adults also warrant attention.

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Appendix. 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

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
    8. DK (Don't Know); NA (Not Ascertained)
    9. RF (Refused)

3. Have you fallen more than 2 months behind on mortgage payments in the past 2 years?

    1. Yes
    5. No
    8. DK (Don't Know); NA (Not Ascertained)
    9. RF (Refused)

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
    8. DK (Don't Know); NA (Not Ascertained)
    9. RF (Refused)

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.

About the author

Ning Tang is an associate professor of finance at the Fowler College of Business of San Diego State University. Her research focuses on household finance, financial literacy and education, retirement decisions and pension plan design. Dr. Tang's studies examined the efficiency of 401(k) plans and target-date funds, behavioral bias in individual retirement decisions, and determinants of financial advice use. She also incorporates insights from psychology, behavioral economics, and financial education in her work on financial literacy. Her research has been published in journals including Journal of Public Economics and Journal of Economic Behavior & Organization. She earned her Ph.D. and M.A. degree in Applied Economics from the Wharton School of the University of Pennsylvania, and her B.S. in actuarial science from the University of Hong Kong.