

# **Savings goals matter - Cognitive constraints, retirement planning, and downstream economic behaviors**

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**Abstract:** We study how cognitive constraints relate to each distinct step of the planning and execution process for retirement, that is, individuals' propensity to plan, savings goals set, and economic outcomes (wealth accumulation and portfolio choice). We find that different cognitive constraints play distinct roles: Higher advanced financial literacy (and quantitative reasoning ability) predicts a greater propensity to plan, while higher basic financial literacy and verbal cognition predict setting higher savings goals. Math-related abilities are not associated with savings goals in a systematic way. Furthermore, our evidence shows that the economic consequences of retirement planning depend on the earlier set savings goals. In comparison to non-planners, only planners with a higher savings goal (above the median) accumulate more wealth and are more likely to hold risky assets and private annuities. Our findings suggest that when crafting public policy to develop individuals' retirement readiness, next to improving financial literacy, other targets could be to enhance cognitive skills and to support setting concrete savings goals by, for example, providing better access to planning relevant information and tools.

**JEL classification:** D91; G51; G52; G53

**Key words:** Retirement planning; savings goal; financial literacy; cognitive abilities; economic behaviors

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## 1. Introduction

Worldwide population aging and the shift of pension systems from defined benefit to defined contribution require individuals increasingly to carry more responsibility to prepare financially for retirement (Gomes et al., 2021). Studying how households differ in their attitudes, capacity, and skills in planning and consequently building up retirement wealth is thus of great concern to researchers and policymakers (Munnell et al., 2021). In this paper, we examine how cognitive constraints influence planning and outcomes, specifically focusing on savings goal setting.

Planning for retirement is a complex process that involves multiple steps, for example, starting to think about retirement, gathering and processing information, setting retirement wealth and asset allocation goals, and executing plans (Lusardi, 2003; Lynch et al., 2010). Naturally, planning creates both informational and psychological costs (Reis, 2006) that may hinder individuals with cognitive constraints to plan properly (Delavande et al., 2008; Hastings et al., 2013). Starting with the seminal contributions of Ameriks et al. (2003) and Lusardi (2003) a rich literature developed that studies the interplay of planning, cognitive constraints - that is, financial literacy and cognitive abilities - and wealth outcomes and asset allocation choices.<sup>1</sup>

Ameriks et al. (2003) and Lusardi (2003) find a positive relationship between individuals' propensity to plan, their wealth accumulated, and whether individuals said they saved money. Hereby, propensity to plan refers to the very first step of planning, that is, having thought about retirement (e.g., Ameriks et al., 2003; Lusardi, 2003) or having tried to figure out how much money one would need to save for retirement (e.g., Lusardi and Mitchell, 2011; Van Rooij et al., 2012).

Subsequent research then investigates the role of financial literacy and to a limited extent cognitive abilities within distinct steps of the retirement planning and execution process. Specifically, financial literacy encompasses financial knowledge and the ability to apply it to personal finance (Huston, 2010). Cognitive ability is defined as the

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<sup>1</sup> A related literature studies the role of financial literacy and cognitive abilities for behaviors beyond retirement planning, that is, credit card usage and home equity loan applications (Agarwal and Mazumder, 2013), mortgage defaults (Gerardi et al., 2010), annuity valuations (Brown et al., 2017; Post, 2023).

general brain-based capability to “reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience” (Gottfredson, 1997).

Behrman et al. (2012) find a direct positive relationship between financial literacy and wealth outcomes. Lusardi and Mitchell (2007, 2011) show that individuals with higher financial literacy have a greater propensity to plan (also found by Hershey et al., 2007; Anderson et al., 2017; Niu and Zhou, 2018; Tomar et al., 2021), and those with a greater propensity to plan accumulate more wealth. Van Rooij et al. (2011a, 2011b, 2012) introduce more fine-grained measurements of financial literacy. They distinguish between basic financial literacy, that is, financial numeracy and understanding of economic concepts for day-to-day financial transactions and advanced financial literacy, that is, knowledge of financial investments and portfolio choice. Using this distinction, they find that especially greater advanced financial literacy predicts a greater propensity to plan (Van Rooij et al. 2011a, 2012; Niu et al. 2020), higher wealth (Van Rooij et al., 2012), and higher stock market participation (Van Rooij et al., 2011b). Finally, higher cognitive abilities predict higher wealth (McArdle et al., 2009; Banks et al., 2010) and higher stock market participation (Christelis et al., 2010).

To this literature we offer four contributions: First, we include in our empirical specifications both, measures of *financial literacy (basic and advanced) as well as cognitive abilities (verbal, math, quantitative reasoning, and memory)*. It is important to study the effects of financial literacy and cognition jointly. Financial literacy and cognitive abilities have been shown to be positively associated within individuals (Boyle et al., 2013; Gamble et al., 2015; Muñoz-Murillo et al., 2020). Especially, innate cognitive abilities are argued to be an important source of omitted variable bias when studying the economic impacts of financial literacy (Van Rooij et al., 2011a, 2011b). Moreover, in some domains financial literacy and cognitive abilities have been found to result in different behavioral predictions (i.e., for seeking financial advice, Kim et al., 2019). Theoretically, different facets between/within financial literacy and cognitive abilities can differ in their proximity or relevance to specific steps or tasks embedded even in a single decision-making process and thus are expected to exert varying

influence. Therefore, if only one of those measures is included in the empirical specification it is difficult to understand their individual and potentially distinct contributions to planning and planning outcomes.<sup>2</sup>

Second, our novel data set allows to analyze individuals' *concrete monetary savings goals* - an important early-stage step of the planning process, shedding light on the intensive margin of retirement planning so far not studied. Setting concrete goals has been shown to be key for successful planning and goal pursuit (e.g., Lynch et al., 2010; Hoffmann and Plotkina, 2021a), and therefore it is important to understand the role of savings goals in the nexus of retirement planning, cognitive constraints, and downstream economic behaviors.

Third, in our empirical specifications studying the propensity to plan, savings goals, wealth outcomes, and asset allocation choices we *keep at each step of the planning and execution process financial literacy and cognition included* which allows us to study their distinct impact over and beyond, for example, predicting singular relationships within the planning and execution process.

Fourth, by studying both financial literacy and cognition across multiple steps of the planning and execution process, our results have the potential to offer *new insights for better targeted policy implications*. Depending on at which step which factor plays which role different implications might follow, for example, investments in financial literacy education vs. improving cognitive abilities at school or behavioral interventions (Willis, 2009) with different aims like increasing planning (Hoffmann and Plotkina, 2021b) vs. goal clarity (Hoffmann and Plotkina, 2021a) or to prioritize which groups of individuals interventions should target<sup>3</sup>.

For our main empirical analyses we use data from the 2014 wave of the China Family Panel Studies for urban households from a nationally representative sample (and in addition for auxiliary analyses waves from 2012 to 2020). The 2014 wave includes a

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<sup>2</sup> Angrisani et al. (2023) include financial literacy and cognition in a model that predicts the propensity to plan for retirement six years ahead finding no significant results. As their right-hand side variables in the regression, however, also include a measure for “general planning attitude” which is potentially correlated with retirement planning and/or financial literacy and cognition it is unclear how to interpret those findings.

<sup>3</sup> For example, Paraboni and da Costa (2021) find that their intervention to boost financial literacy is not effective for individuals with higher cognitive abilities.

special module eliciting individuals' propensity to plan (yes or no question as in Lusardi and Mitchell, 2011 or Van Rooij et al., 2012), savings goal using the question "What is the amount of money you or your spouse need to save for your retirement?", basic and advanced financial literacy (similarly measured as in Van Rooij et al. 2011b), and verbal and mathematical cognition. In addition, further measurements included in the wave allow us to control for factors that have been shown to be correlated with planning, financial literacy, cognition and/or wealth outcomes and asset allocation choices like classical preference parameters (risk aversion and patience), behavioral traits (present bias), and a wide range of demographic and socio-economic variables (Laibson, 1997; O'Donoghue and Rabin, 1999; Frederick, 2005; Dohmen et al., 2010; Benjamin et al., 2013; Tomar et al., 2021).

Our economic setting is comparable with many Western economies, like the U.S., in that individual planning and saving are important to secure a healthy financial situation in retirement. Currently, Chinese households' old-age provision relies heavily on the pay-as-you-go social pension. However, rapid population aging threatens the sustainability of the public pension system. Since the 1997 pension reform to foster a multipillar system, the target replacement ratio of the social pension for urban employees has declined (Feng et al., 2011) and is now at only about 45% according to the China Ageing Finance Forum (CAFF50). Meanwhile, the second pillar (occupational pension plans) develops slowly and has a very limited coverage<sup>4</sup>. In order to enhance the individual saving (i.e., the third pillar), the Chinese government recently has implemented a series of public policies, for example, piloting individual tax-deferred commercial endowment insurance and rolling out a voluntary private pension plan. However, contrary to the growing needs to build up personal savings for retirement, many survey results point out that households are not preparing financially enough for retirement.<sup>5</sup> This fact is further exacerbated by the decaying trend of social norms in family support, wherein rearing children was traditionally seen as a means to

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<sup>4</sup> According to the Ministry of Human Resources and Social Security of the People's Republic of China, at the end of 2021, about 27.2 million urban employees participated in occupational pension plans which comprised less than 6.0% of the total urban employees insured by the Urban Employee Basic Pension Scheme.

<sup>5</sup> The China Ageing Finance Survey 2021, conducted by the CAFF50, reveals that about 32% respondents' accumulated retirement wealth is below 100 thousand yuan (around 15 thousand U.S. dollars).

provide for old age (Chen et al., 2019).<sup>6</sup>

Our results show that, setting concrete monetary savings goals is an important building block in understanding the relationship between cognitive constraints, planning, and economic outcomes. Moreover, while we are able to by and large replicate the singular relationships between certain cognitive constraints and variables of planning and outcomes documented in earlier literature, our strategy to include more fine-grained measures of cognitive constraints jointly and at each step of the planning and execution process allows us to get a more detailed understanding of mechanisms, which constraints matter when and their relative importance.

In particular we find that, higher advanced financial literacy is related to a higher probability of being a planner. Further analyses suggest higher advanced literacy (i.e., knowledge of financial investments and portfolio choice) enhances retirement and wealth-management awareness and, thus, higher motivation to plan for retirement. Among planners then, those with higher basic financial literacy and verbal cognition set higher savings goals. By analyzing sub-components of basic financial literacy we find that the correct understanding of the effects of inflation is key to setting higher savings goals. We provide evidence consistent with that having higher verbal cognition is positively associated with better skills in locating, searching, and comprehending information - thus important skills required for setting a concrete savings goal. Crystallized mathematical cognition and fluid quantitative reasoning (available in different waves and studied as a robustness check) do not relate to savings goals set (hinting at that such skills are more important for the precision of calculations), while the latter has a statistically significant but economically small effect predicting being a planner in comparison to advanced financial literacy. Memory (measured together with quantitative reasoning) neither relates to the probability of planning nor savings goals.

Importantly, we also observe that having said to having planned also translates into

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<sup>6</sup> According to the 2013 wave of the China Household Finance Survey, which also features national representativeness, 19.6% (23.4%, 8.9%) of urban residents plan to rely on savings, investments, and/or commercial pensions (social pensions, children and relatives) to prepare for retirement. To exclude the possibility that cognitive constraints influence different choices of old age provision, we control for social pension measures (including participation status of each social pension and subjective perceptions of social security problems) as well as individuals' having traditional views on parent-child relationships and family support (indicated by family size and interaction with relatives).

economic action and effects found are conditional on the savings goals set. Different from non-planners, planners with a higher savings goal (above the median) accumulate both more net wealth and gross financial assets. Those planners also invest more into risky assets and purchase more private annuities. Planners with lower savings goals do not show these distinguished patterns. The goal dependence of how retirement planning relates to downstream economic outcomes is obscured in previous literature, which primarily documents a general positive effect of planning on wealth accumulation, and could be a reason for the limited and contradictory findings regarding relation of planning with stock holding.<sup>7</sup> Furthermore, similarly as in Jiang et al. (2024) study of the Big Five personality traits we document the domain specificity of each cognitive constraint regarding its relation with downstream economic outcomes: basic financial literacy, as a more general measure capturing understanding valuable for a broader range of asset categories, stands out as a robust factor for explaining wealth accumulation while advanced financial literacy, capturing knowledge related to financial investments, explains risky asset and annuity holdings. Cognition, especially math-related (including quantitative reasoning) is related to higher wealth accumulation and stock market participation.

Our results are economically significant: A one standard deviation increase in basic financial literacy and verbal cognition increase savings goals by 8.9% and 12.4%, respectively. Planners with higher planned savings (above the median) have about 60.0 (9.3) thousand yuan higher net wealth (gross financial assets) than non-planners, which is about 18.4% (46.7%) of the sample median, and their participation in the stock (risky financial asset) market and annuity holdings goes up by 4.4% (6.4%) and 3.6%, about 32.3% (43.8%) and 82.4% of the sample averages.

Note, while our main econometric specifications are cross-sectional the causality of effects found is very likely to run from cognitive constraints to planning, savings goals, and economic behaviors. Regarding financial literacy we build on earlier evidence that

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<sup>7</sup> Lusardi (2003) documents a lower probability of stock ownership for those who have hardly thought about retirement while Ameriks et al. (2003) find no effect of planning on either stock ownership or stock's share of financial assets (note, though over 90% in their sample are stock owners).

found temporal stability (e.g., Alessie et al. 2011; Angrisani et al. 2023). Regarding cognitive abilities, for which we have measurements available in multiple survey waves, our own tests show temporal stability. Finally, in our wealth regressions we control for past survey wave's wealth to rule out that the causality runs from wealth levels to planning and savings goals.

Overall, our results demonstrate that different facets of financial literacy and cognitive abilities are relevant at distinct stages of the planning and execution process for retirement and setting concrete savings goals is key for successful retirement wealth accumulation. In regard to policy implications, our results point at a new challenge. Next to increasing individuals' financial literacy - which is a challenge of its own (see Fernandes et al., 2014) - cognitive skills need close attention. That is, initiatives might either try to improve those (most likely through school curricula) or provide help that can substitute for limited abilities. For example, providing easily accessible planning tools, interventions to increase goal clarity (Hoffmann and Plotkina, 2021a), and communicating retirement relevant information in an easy to process and understand language (Nell et al., 2018; Hoffmann and Plotkina, 2020).

The structure of this paper is as follows: In Section 2, we introduce the data and sample selection procedure, define variables, and provide descriptive statistics. Our main results we present in Section 3. Section 4 contains robustness checks. In Section 5, we conclude and discuss implications.

## **2. Data**

### **2.1 The China Family Panel Studies**

The China Family Panel Studies (CFPS) is a nationally representative<sup>8</sup>, biennial, longitudinal household survey launched in 2010 by the Institute of Social Science Survey of Peking University (Xie and Hu, 2014). It collects a rich variety of detailed individual- and family-level data. In 2014, CFPS conducted a special module for households living in urban communities to measure their financial literacy and

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<sup>8</sup> The CFPS covers 25 provinces, excluding Xinjiang, Tibet, Qinghai, Inner Mongolia, Ningxia, Hainan, Hong Kong, and Taiwan, which encompass about 94.5% of the total population in Mainland China.

retirement planning (tests of cognition are included in the standard question set of the CFPS). This module was answered by the respondent in the household who is most familiar with household finances. Thus, we can expect that those respondents are most involved in a household's economic decisions.

A total of 3,908 respondents participated in this special module. Among them, 3,885 answered the question about whether they or their spouse have calculated the amount of savings needed for retirement (i.e., the propensity to plan measure). Almost all respondents - except one - who answered yes to the former question gave an exact amount of planned savings goals (1,235 observations). We exclude observations with savings goals at the 1% tails on both sides to avoid extreme values<sup>9</sup> (65 observations). Then, we keep only non-retired respondents (2,450 observations left)<sup>10</sup> as retirement planning (and especially retirement savings goal setting) is more relevant before retirement.<sup>11</sup> Finally, we also exclude observations with missing values for independent variables (four types of financial literacy and cognitive abilities, 7 observations) and control variables (212 observations) in the regressions of being a planner, with 2,231 observations left in total.<sup>12</sup>

## 2.2 Variables and descriptive statistics

With respect to planning for retirement, the 2014 wave of CFPS asked respondents "Have you or your spouse ever tried to figured out how much you need to save for retirement?" with response options given as "yes", "no", and "do not know". We construct a dummy variable, indicating being a planner, which takes the value of 1 if respondents choose yes, and 0 otherwise. Similar as in U.S. (e.g., 31.3% in Lusardi and Mitchell, 2011) or Dutch (e.g., 37.4% in Van Rooij et al., 2012) samples, we find that a

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<sup>9</sup> The mean, standard deviation, minimum, and maximum of savings goals are 93.0, 590.2, 0.2, and 10,000 (in 10,000 yuan) before exclusion and 42.3, 65.3, 1.2, and 900 (in 10,000 yuan) after exclusion. The 1% tail of left side is 10,000 yuan which has a relatively large cluster of 45 observations.

<sup>10</sup> 1,287 respondents who are already retired and 83 respondents with missing values on retirement status are dropped.

<sup>11</sup> The savings goal question might also be confusing for retired respondents as it is unclear whether it refers to savings they originally needed for their entire retirement phase or an amount needed for their remaining lifetime.

<sup>12</sup> The observations differ for specific downstream economic behaviors (2,182 for net wealth and 2,209 for gross financial assets because of missing values while 2,084 for two measures of risky asset holdings and 2,087 for private annuity holdings because of both missing values and that we control for the natural logarithm of net wealth).

lack of retirement planning is also present in China: only 31.4% of respondents indicated that they did plan. Different, however, to the U.S. Health and Retirement Study respondents in our sample select more often (34.3%) the “do not know” option. In the U.S. data this fraction is about 1% (Lusardi and Mitchell, 2011) while in the Dutch DHS survey questionnaire this option was not available to respondents. As it is unclear if this response chosen reflects a clear lack of planning<sup>13</sup> and given its high prevalence, we report in Section 4.1 the results excluding respondents choosing the “do not know” from the sample as a robustness check.

Following this question, the module then further asked those who responded with “yes” (i.e., planners) about their specific retirement savings goal with the question “What is the amount of money you or your spouse need to save for your retirement?” The responses to this question we use for our variable “savings goal”. The mean and median savings goals are about 478 and 300 thousand yuan, which are about 16.6 and 11.3 times the amount of the mean (28,844 yuan) and median (26,635 yuan) annual disposable income of urban residents, respectively, according to the 2014 Statistical Bulletin on National Economic and Social Development. The detailed distribution is displayed in Figure 1a. In regression models, we take the natural logarithm transformation of this variable (see Figure 1b) to address the variable’s skewness and potential outliers.

-- Figure 1a, 1b here --

Financial literacy is elicited based on a series of 10 questions similar to those used by Van Rooij et al. (2011b), distinguishing between basic and advanced financial literacy (see Appendix Table A1 for details). The basic financial literacy questions

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<sup>13</sup> A reason for the high fraction of “do not know” answers is potentially related to the wording and execution of these questions. First, the planner question asks about planning of either the financial respondent or their spouse. Consequently, those who had not planned for retirement and were uncertain whether their spouse had done might have chosen “do not know”. Consistent evidence is that the fraction of “do not know” responses for individuals that were never married is 19.8%, compared to 35.7% for individuals (once) married or partnered. Another reason might be that prior to proceeding with the special financial module, interviewers were reminded that *the questions in this module should be answered by the same respondent themselves, without allowing proxy answers, prompts, or mid-interview respondent changes*. Thus, respondents are more likely to have unclear answers when not getting enough prompts from others.

measure knowledge in the financial domain and test the understanding of economic concepts necessary for day-to-day financial transactions. They include four questions regarding interest numeracy, interest compounding, inflation, and time value of money. The advanced financial literacy questions measure knowledge about financial investments and portfolio choice. They include six questions regarding diversification, risk properties of different financial products, the definition of stocks, the characteristics of mutual funds, the characteristics of banks' wealth management products, and the function of the stock market. For creating a composite measure for basic and advanced financial literacy, we first construct binary variables for correct answers and binary variables for do-not-know answers, and then, perform a factor analysis to obtain the Bartlett score for the first extracted factor, using the iterated principal factor method (as in van Rooij et al., 2011b). The resulting first extracted factors describe a large share (67.2% and 58.5%) of the variation of basic and advanced financial literacy questions with an eigenvalue of 3.7 and 4.6, respectively. The corresponding overall Kaiser-Meyer-Olkin measures of sampling adequacy are reasonably high at 0.790 and 0.838, suggesting suitability for a factor analysis.

The CPFS has two common built-in modules for assessing cognition which rotate every four years (see details about their design in Appendix B). In the 2014 (also 2010 and 2018) wave, the module's questions measure respondents' crystallized intelligence (knowledge and skills acquired from prior learning and experiences) specifically with regard to verbal and mathematical abilities using a vocabulary and numeracy test, respectively (Huang et al., 2015).<sup>14</sup> The questions of the two tests in the survey are sorted by increasing complexity and presented to the respondent one by one. The final score for each test is given by the serial number of the last question that is answered correctly. In the later analyses, we distinguish between the verbal and mathematical

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<sup>14</sup> Many studies such as Bianchi et al. (2022), Chen et al. (2022), and Huang and Liu (2023) also utilize the sample from CPFS and these two tests as measures for the respondents' cognition. Similar tests can also be found in the HRS/AHEAD and the Cognitive Economics Survey (CogEcon) in the U.S, where they also measure a respondent's established knowledge using a vocabulary measure (asking them to define 5 given words) adapted from a revised form of the Wechsler Adult Intelligence Scale (WAIS-R) and mathematical computations (including addition, subtraction, multiplication, division, and combinations of these basic operations, as well as some geometric, trigonometric, logarithmic, and calculus operations) adopted from Woodcock-Johnson III Tests of Achievement (McArdle et al., 2009).

cognition measure.

The CFPS also measures fluid intelligence (ability to reason and think flexibly, using a quantitative reasoning and memory tests (Huang et al., 2015)) in other waves (2012, 2016, and 2020). We analyze these measures as a robustness check (Section 4.2).<sup>15</sup>

To study downstream economic behaviors, we include several indicators of individuals' saving and portfolio choice decisions. The former is captured by a household's net wealth and gross financial assets, while the latter are risky asset and private annuity holdings. Net wealth is the sum of gross financial assets (cash, deposits, stocks, mutual funds, government bonds, financial derivatives, other financial products like futures and options, and money lent to others), net housing wealth, other non-financial assets (land, durables, and productive fixed assets), minus all non-housing debts. For risky asset holdings, we construct a binary variable indicating stock market participation (overall financial investment holdings) taking the value one if a respondent holds either stocks or mutual funds (as well as government bonds<sup>16</sup>, trust products, foreign exchange products, or other financial investment products). The binary variable indicating private annuity holdings takes the value one if a respondent holds a private annuity for themselves. In our sample, participation rates in all financial assets are low: only 13.5% (14.7%) hold stock-related (financial investment) products and 4.3% of respondents hold private annuities.

In our analyses, we also control for a variety of respondents' demographic and socio-economic characteristics including age, gender, marriage status, education, employment status, self-reported health, types of social or occupational pension coverage, household registration status (*hukou*), holding traditional views, family size, relationships with relatives, and the natural logarithm of household income. These factors have been found to be related with financial literacy and cognitive abilities (Huang et al., 2015; Eberhardt et al., 2019; Muñoz-Murillo et al., 2020) and/or economic behaviors. For education, we include three binary variables indicating the

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<sup>15</sup> Those measures are not included in the main specifications as doing so results in a non-negligible loss (nearly 20%) of observations even after averaging across waves.

<sup>16</sup> We include government bonds as in Guiso and Zaccaria (2023), since the survey questionnaire treats them as one type of financial investment. However, our results remain the same when we do not include them.

highest education level achieved is middle school, high school, college and above (vs primary school or no schooling).<sup>17</sup> We incorporate a variable indicating whether the household is suffering from financial difficulty, which might reflect respondents' financial risk awareness (Lusardi, 2003), and subjective evaluation of problems within the social security system, to capture a potential substitution effect between private and government pensions, as higher expected social pension benefits have been found to have a positive effect on current consumption decisions (Zheng et al., 2023).

Finally, we include a set of controls regarding respondents' preferences and behavioral traits, which have been found to be related to planning, financial literacy, cognition, wealth outcomes, and/or asset allocation choices. That is we include measures of patience, risk aversion, and present bias (Laibson, 1997; O'Donoghue and Rabin, 1999; Frederick, 2005; Dohmen et al., 2010; Benjamin et al., 2013).

Definitions of variables and descriptive statistics are given in Table 1.

*--Table 1 here--*

We report in Appendix Table A2 pairwise correlations using all available observations<sup>18</sup> to preliminarily examine relations between variables of interest. First, basic and advanced financial literacy as well as verbal and mathematical cognition are positively correlated with each other. However, there is still ample heterogeneity of other cognitive measures within sub-samples divided by one cognitive measure.<sup>19</sup> Second, there is a strong negative (positive) relationship between age (education levels) and each measure of financial literacy and cognitive abilities.<sup>20</sup> Similarly, large

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<sup>17</sup> The education level dummies also help to address the confounding effects with respect to the special design of cognition tests, resulting from different initial questions (see Appendix B).

<sup>18</sup> Using only planners' observations results in similar correlations.

<sup>19</sup> The coefficients of variation of verbal (mathematical) cognition are 0.269 (0.460) and 0.424 (0.585) for the basic financial literacy groups above and below the median, respectively, and are 0.244 (0.440) and 0.443 (0.603) for the advanced financial literacy groups. The coefficients of variation of verbal (mathematical) cognition are 0.165 (0.375) and 0.465 (0.617) for the mathematical (verbal) cognition groups above and below the median. The coefficients of variation of basic (advanced) financial literacy for the groups divided based on other cognitive measures are misleading as the two measures of financial literacy include negative values.

<sup>20</sup> Note, that the cross-sectional negative correlation of age and cognitive abilities may not capture the true age profile, which could also be driven by cohort differences in, e.g., educational attainment (Huang et al., 2015). Previous literature shows that crystallized intelligence usually increases gradually and remains relatively stable throughout most of adulthood (Cavanaugh and Blanchard-Fields, 2006). Our analysis, using the panel sample data from the 2014 and 2018 waves and hierarchical age-period-cohort (HAPC) models which in addition include a linear

variation still exists within different age or education groups which is important for exploring separate effects of age, education level, and cognitive constraints.<sup>21</sup> Male respondents exhibit higher financial literacy and mathematical cognition (the latter association is consistent with Halpern, 2011) and a disparity in cognitive abilities between respondents with rural and urban *hukou* is obvious (as also documented by Huang et al., 2015). Third, the two measures of retirement planning (propensity to plan, savings goal) are positively related to different subcomponents of financial literacy and cognitive abilities, suggesting that cognitive constraints are involved in retirement planning and savings goal setting. Furthermore, the relationships between savings goals (as well as financial literacy and cognitive abilities) and economic outcomes are more often positive and significant than with being a planner. We defer in-depth inferences to the multivariate regressions presented in the next section.

### 3. Empirical results

#### 3.1 Cognitive constraints and retirement planning

##### 3.1.1 Empirical identification and temporal stability of cognitive measures

We estimate predicting being a planner and the savings goals set using the following general model:

$$Planning_i = \alpha + \beta FL_i + \theta Cognition_i + \gamma Controls_i + \lambda_p + \varepsilon_i, \quad (1)$$

where *Planning* represents either being a planner or savings goal for individual *i*, *FL* and *Cognition* represent individual *i*'s financial literacy and test scores of cognitive abilities, respectively. *Controls* are a vector of control variables aforementioned. We further include province fixed effects,  $\lambda_p$ , to address regional differences in economic development and aging culture. We estimate model (1) using linear probability models and calculate heteroskedasticity-robust standard errors.

Our identification strategy for the impact of cognitive constraints on retirement planning relies on the assumption of within-individual temporal stability of financial

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cohort effect as in Bell and Jones (2015) (equation 10.6), shows that the two crystallized cognition measures do increase with age.

<sup>21</sup> For example, the coefficients of variation of verbal and mathematical cognition are 0.257 and 0.461, respectively, for the age group below the median, and are 0.185 and 0.367 for the college group. These figures are the smallest compared with those for other age or education groups.

literacy and cognitive abilities. Angrisani et al. (2023) use longitudinal data of the RAND American Life Panel covering a period of six years and document that financial literacy is rather stable within individuals, that is, constant at young and middle ages and only dropping slightly at older ages. Based on their evidence they argue that causality runs from literacy to planning and wealth outcomes and not the other way round (i.e., planning or wealth gives incentives to acquire financial literacy). Likewise, Alessie et al. (2011) document that financial literacy for Dutch individuals did not change during the period from 2005 to 2010. Similarly, cognitive abilities are found to be temporally stable as well in rank order among individuals after being grown up (Borghans et al., 2008; Almlund et al., 2011), and, thus, are as well unlikely to suffer from endogeneity, as retirement planning usually starts after entering the work force (Christelis et al., 2010).

Given the panel design of the CFPS, we also utilize the balanced panel sample, roughly half of the total sample, from the 2014 and 2018 waves to analyze temporal stability of cognitive abilities. First, the serial correlation of vocabulary (numeracy) test scores at four-year intervals reaches a high level of 0.670 and 0.672, respectively (higher than the estimate (0.6) of a composite cognitive ability measure in Kuhnen and Melzer (2018) for U.S. data from the National Longitudinal Survey of Youth). Second, the average cross-sectional standard deviations of the vocabulary test scores (7.848) and numeracy test scores (5.621) are considerably larger than the average within-respondent's time-series standard deviations (2.831 for vocabulary and 1.892 for numeracy), which implies that cross-sectional information provides most variation. Finally, we sort respondents into score deciles of each test for the 2014 wave. Then, we calculate the group averages of their test scores for the 2018 wave. Appendix Figure A1 shows a monotonically temporal relationship across the sorted groups for the two tests of cognitive performance.

### **3.1.2 Empirical results**

In Table 2 we present the estimation results with only controls for demographic and socio-economic characteristics in columns 1 and 3, and we additionally include controls

for preferences and behavioral traits in columns 2 and 4. Consistent with previous literature (Van Rooij et al., 2011a, 2012; Niu et al. 2020), advanced financial literacy is positively and significantly related to the probability of being a planner (columns 1 and 2). Basic financial literacy and both cognition measures do not predict being a planner. Higher savings goals are predicted by both having higher basic financial literacy as well as verbal cognition (columns 3 and 4).

The effects we find are also economically significant. Based on the results with full controls (columns 2 and 4), a one standard deviation increase in advanced financial literacy increases the likelihood of being a planner by 7.8%, which is about 25.0% of the sample average. A one standard deviation increase in basic financial literacy and verbal cognition is associated with an increase in savings goals by 8.9% and 12.4%, respectively.

As the four measures of financial literacy and cognitive abilities are correlated to some extent, we also run regressions with the full sets of controls that include those measures separately (first four panels of Appendix Table A3). Included separately, basic and advanced financial literacy, and the two cognition measures are all positively related to being a planner. That is, all four measures play a role, but advanced financial literacy has greater explanatory power. In the savings goal regressions, the coefficients for math cognition and advanced financial literacy stay insignificant.

The above results show that different types of financial literacy and cognitive abilities are relevant in different stages of the planning process. As the very first step in setting up a retirement plan, advanced financial literacy, that is, having knowledge of financial investments and portfolio choice might enhance retirement- and wealth-management awareness (Anderson et al., 2017) and, thus, higher motivation to plan for retirement. To test this mechanism, we construct a variable indicating individuals' planning awareness.<sup>22</sup> Advanced financial literacy is positively related to general planning awareness (Appendix Table A4, column 1) which then further results in higher

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<sup>22</sup> This variable is constructed by averaging the agreement level from responses to two statements: "I pay very close attention to my financial situation" and "I will collect product information and compare various types of products when I choose financial products (e.g., stocks, bonds, funds, options, futures, and foreign exchanges)". The choices are "1 = totally inapplicable", "2 = somewhat inapplicable", "3 = generally applicable", "4 = somewhat applicable", "5 = totally applicable". We drop observations stating "do not know".

probability to plan for retirement (column 2).

To better understand why basic financial literacy is related to higher savings goals we analyze the measure's sub-components following Lusardi and Mitchell (2007, 2011). We replace basic financial literacy in the model with several binary variables indicating both correct answers and do-not-know answers. Answering the inflation question correctly is related to 22.7% higher savings goals (column 5).<sup>23</sup> That is, respondents that understand that inflation erodes the real value of savings set in response higher goals.

Finally, our finding that only verbal cognition (vs. math cognition) predicts having higher savings goals seems to suggest that for engaging in a concrete, long-term planning procedure, the ability (self-efficacy) to know how and where to search for information, and then read and comprehend this information is important (as argued by Eberhardt et al., 2022). To test this conjecture, we employ the usage of the Internet given that the Internet plays as an important role in decreasing information frictions when making economic decisions (Bogan, 2008; Liang and Guo, 2015). As shown in the columns 3 and 4, we find that higher verbal cognition is positively related to the usage of the Internet (column 3) and the latter is positively related to higher savings goals (column 4). Interestingly, higher math cognition does not predict higher savings goals, which could reflect that math cognition matters more for accuracy of calculation results for an already clearly defined problem (as in Post, 2023) and hence does not predict systematically higher or lower amounts.

With respect to individuals' preferences and traits we find that patience is positively associated with a higher probability of being a planner and also higher savings goal suggesting that patient individuals are more willing to substitute current with future consumption (Table 2, columns 2 and 4). Similar as in van Rooij et al. (2012) analyzing Dutch data on actual savings, risk aversion is negatively related to savings goals. Potentially, "saving" might be associated in the Chinese context with putting money

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<sup>23</sup> According to the National Bureau of Statistics, the inflation rate was 2.0% in 2014 and the average annual rates were 2.9% over the preceding ten years from 2014 and 1.9% from 2014 to 2022. If we assume a fixed annual rate of 2%, the increase in 10 years would approximately amount to 22%.

into risky assets (which is in line with our findings for the risky asset holding analyses in section 3.2.2). Interestingly, those with higher present bias plan for higher savings which may be a reflection and projection of their higher consumption needs. Importantly, including preferences and traits in the model does not fundamentally change estimated coefficients of financial literacy and cognitive abilities, neither statistically nor economically, further highlighting the importance of cognitive constraints for retirement planning.

Note, regarding other control variables, we find that higher education, specifically, college education and above relates negatively to being a planner (which is also found by Van Rooij et al., 2011a) but positively to savings goals. Potentially, education levels also represent (permanent) earnings capacity (Banks et al., 2010), which first might lower the motivation for retirement planning (Lusardi, 2003; Hershey et al., 2013) then - reflecting an expected increasing standard of life increase savings goals. It also demonstrates the importance of separating the impact of cognitive constraints from education, as the latter may have multiple functional mechanisms (Banks et al., 2010).<sup>24</sup>

--Table 2 here--

### 3.2 Economic outcomes of retirement planning

We employ the following general model to study the downstream economic behaviors:

$$Economic\ behaviors_i = \alpha + \beta FL_i + \theta Cognition_i + \delta Planning_i + \gamma Controls^{(+)}_i + \lambda_p + \varepsilon_i, \quad (2)$$

where *Economic behaviors* represents either wealth, risky assets, or private annuity holdings. *Controls*<sup>(+)</sup> represents all the controls in model (1) (as well as an additional control variable of the natural logarithm of net wealth (with about 4.4% of zero and negative observations excluded) when the dependent variable is portfolio choice to

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<sup>24</sup> In panel E of Appendix Table A3 we drop all the four measures of financial literacy and cognitive abilities and find a negative but insignificant effect of education level (High school and College) on being a planner while a positive and significant effect on savings goal. We also drop education level dummies in panel F and see that our effects found for both basic and advanced financial literacy and cognitive abilities on retirement planning hardly change, showing little evidence of multicollinearity issues resulting from including the education level dummies.

distinguish with the wealth effects of retirement planning).<sup>25</sup>

Following Lusardi and Mitchell (2007) and Banks et al. (2010), we estimate model (2) using median regressions when the dependent variable is wealth (net wealth and gross financial assets), considering that the variable is highly skewed (skewness = 4.05/6.97) and contains potential outliers. We estimate model (2) using linear probability models when we investigate portfolio choice.

### **3.2.1 Wealth accumulation**

Being a planner is positively and significantly related to higher net wealth accumulated (Table 3, column 1). Economically, the effect size is 23.5 thousand yuan, about 7.2% of the median. The figure is smaller compared with the one in Lusardi and Mitchell (2007) (20%). Their sample, however, consists of relatively older individuals (in the 51-56 age range) compared to our sample, thus their respondents had more time to accumulate wealth. Higher savings goals are significantly related to higher net wealth (column 2). Economically, a 100% increase in planned savings translates into about 11.7% increase in net wealth.

Our estimates demonstrate that there is thus substantial heterogeneity in wealth accumulation even among those who have planned for retirement with respect to setting a savings goal. To look further into heterogeneity we split planners into two groups based on the median savings goal (300 thousand yuan), and include them in the regressions by replacing the planner measure. Only those who have set relatively higher goals (high group) have accumulated more wealth compared to non-planners (with the effect size being 18.4% of the sample median) (column 3).

We find a similar result when analyzing gross financial assets which also correlate positively with higher savings goals. In this case, a 100% increase in planned amounts is associated with 29.9% increase in gross financial assets (which is a larger effect size than in the net wealth regression as financial assets are typically smaller than net

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<sup>25</sup> When the dependent variable is stock market participation or financial investment holdings, we exclude the value of all financial products (stocks, mutual funds, government bonds, financial derivatives, and other financial products) from net wealth (Van Rooij et al., 2011b).

wealth).

Importantly, even when including planning measures in the model, higher financial literacy and cognitive abilities are related to higher wealth. While the coefficient for basic financial literacy is significant across specifications, advanced financial literacy and cognition seem to relate more to higher gross financial wealth, but not to net wealth. This pattern might be driven by the fact that basic financial literacy, captures general understanding of a broader range of asset categories (not constrained to financial investments) and is thus essential in explaining non-financial assets, especially housing.<sup>26</sup> With respect to economic importance, the impact of being in a high group on net wealth (gross financial assets) is over four times (around five times) as large as a one standard deviation increase in basic financial literacy, as calculated from columns 3 and 6. Advanced financial literacy and math cognition have effect sizes, measured in a one standard deviation increase, on gross financial assets that are over 0.5 times larger than those of basic financial literacy.

*--Table 3 here--*

There might be reverse causality in that wealthier individuals may have more economic resources for planning (Lusardi and Mitchell, 2007).<sup>27</sup> Conversely, those may also have less incentive to plan if they have already accumulated sufficient savings for retirement. To address this potential bias, we employ a change model to assess whether retirement planning predicts short-term changes in wealth (Berkowitz and Qiu, 2006; Ye and Post, 2020). That is, we include net wealth from the 2012 wave as an extra control in model (2).

Using this specification, the effect of planning is only significant in the gross financial assets specification, and higher savings goals predict significantly and positively with higher wealth for both measures (see Appendix Table A6). Moreover,

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<sup>26</sup> In Appendix Table A5, we show that only basic financial literacy is positively and significantly associated with net wealth excluding gross financial assets and net housing wealth.

<sup>27</sup> In panel G of Appendix Table A3 we account for the influence of wealth in the regressions of being a planner and savings goal by controlling for the natural logarithm of net wealth from the 2012 wave and the results hold similarly as in Table 2.

planners with a lower savings goal even have significantly lower short-term net wealth accumulation compared with non-planners. The above results indicate that the positive effect of savings goals on wealth accumulation is robustly pronounced, and based on their savings goal respondents have a systematically different wealth accumulation path in that that planners with a higher goal typically save more but it is not the case for planners with a lower one. This is an important new finding in that planning per se does not necessarily result in more wealth accumulated.

### **3.2.2 Risky asset holdings**

The results for stock market participation (first three columns) and overall financial investment holdings (last three columns) are presented in Table 4. On average, being a planner does not significantly relate to the probability of holding risky assets (column 1) while higher savings goals are positively related (column 2). A 100% increase in a savings goal is related to 2.4% higher likelihood of holding risky assets, which is about 15.8% of the sample average and similar to the effect size of net wealth. The effect from planning on holding risky assets is conditional on setting higher savings goals. When differentiating again between the high and low goals groups we observe that planners with a higher savings goal are 4.4% more likely to hold risky assets, accounting for 32.3% of the sample average (column 3). The effect of higher savings goals on financial investment holdings is also positive but estimated with less precision. However, we also find that those with high goals are 6.4% more likely to hold in financial products (near 44% of the sample median).

Overall, the results indicate that planners with a higher savings goal have a greater likelihood to hold risky assets potentially because they understand that doing so will result in higher expected returns.

Consistent with that conjecture, advanced financial literacy, that is, knowledge of financial investments and portfolio choice, is positively related to holding risky assets. Its effect size with respect to a one standard deviation increase is comparable with the effect of being in the high group. The relation between cognitive ability and holding risky assets documented earlier we do not observe in our main specification but in a

robustness check (see Section 4.2).

*--Table 4 here--*

### **3.2.3 Private annuity holdings**

The results of regressing private annuity holdings on retirement planning are shown in Table 5. Similar to the previous section, the estimated coefficient of being a planner is positive but insignificant while that of savings goal is positively related to holding annuities (see columns 1 and 2). The economic importance is profound in that a 100% increase in a savings goal is associated with 3.0% higher probability of holding an annuity, which is about three times as large as the effect of net wealth. Meanwhile, we see in column 3 a differential pattern of annuity holdings for low and high groups compared with non-planners, as the former group shows no significant difference in the probability while in the latter group there exists a positive and significant planner effect. Respondents from this high group have on average 3.6% higher probability to hold annuities, which is over 80% of the sample average.

The above results imply that planning for retirement with a higher savings goal increases the awareness and hence need to manage individual longevity risk, in case outliving may do harm to disrupt individual savings plan. The economic magnitude also implies that annuity decisions are mainly made under retirement concerns.

Higher financial literacy is positively related to holding annuities. The resulted difference between the 10<sup>th</sup> and 90<sup>th</sup> percentile of advanced financial literacy is similar to the effect of being in the high group.

*--Table 5 here--*

## **4. Robustness checks**

### **4.1 Excluding “do not know” answers**

Conceptually, respondents answering “do not know” to the question regarding being a planner should be classified as most likely having not planned for retirement.

However, there might be cases where some planning happened (e.g., by a spouse) and thus categorizing those respondents strictly as not having planned could underestimate our effects. As a robustness check, we report in Appendix Table A7 results for analyses including planner related variables where we exclude respondents with those ambiguous answers from the sample.

In all the specifications the results are qualitatively in line with our main specifications while the estimated coefficients and their precision often increases. For example, the relation of being a planner with gross financial assets and financial investment holdings are significant at the 10% level in this case (columns 4 and 8). Higher verbal cognition is now also significantly related to the probability of planning although the effect size is smaller compared to that of advanced financial literacy (a one standard deviation increase in the two variables relates to 3.0% and 7.1% increase in the planning probability, respectively). Higher verbal cognition is also significantly related to higher net wealth accumulated.

## 4.2 Exploring alternative measures of cognitive constraints

In waves other than the 2014 wave we use for our main specifications, the CFPS also employs two different cognition tests, that is, number series and word recall, aiming to measure respondents' fluid intelligence of quantitative reasoning and memory. Here we test whether these cognitive measures relate to planning as well, as they are different from acquired knowledge and skills that we rely on in our main specifications. Based on the arguments about temporal stability of cognitive abilities mentioned in Section 3.1.2<sup>28</sup>, we follow the strategy of Parise and Peijnenburg (2019) in that we average the available scores of each test across the 2012, 2016, and 2020 waves to increase the number of non-missing observations.<sup>29</sup> Then, we include them in the regression models

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<sup>28</sup> We also provide several statistics to show the temporal stability of quantitative reasoning and memory performance. First, the serial correlation of quantitative reasoning (memory) test scores at four-year intervals is as high as 0.347 (0.423). Second, the average cross-sectional standard deviation of quantitative reasoning scores (34.609) and memory test scores (3.157) are twice as large as the average within-respondent's time-series standard deviations (16.142 and 1.647). However, there seems more time-variation compared with vocabulary and numeracy test scores. Thus, averaging test scores across waves also helps to reduce fluctuations across waves due to reporting errors and isolate the fundamental differences among respondents (Parise and Peijnenburg, 2019).

<sup>29</sup> Due to the survey design, missing values are an especially relevant issue for the test of number series in the 2012 wave. Among 2,231 respondents we have in the baseline model, only 1,237 have valid observations in this test this

regarding retirement planning (Appendix Table A8). The test score for number series cognition is positively related with planning for retirement (columns 1 and 2). Its economic significance, however, is smaller compared to advanced financial literacy. A one standard deviation increase in the number series score results in a 2.7% higher probability of being a planner, while the corresponding figure for advanced financial literacy is 8.1%. Again, we do not find a relationship between test scores for number series and savings goals (column 2), further suggesting that mathematical-related ability does not predict a higher or lower savings goal in a systematic way. Based on the results in the even columns, it does not appear that memory is an important factor in either stage of retirement planning. Moreover, the coefficients for basic financial literacy and verbal cognition are still consistently significant in the regressions of savings goal. We also report the results of economic consequences of retirement planning controlling for the two cognitive abilities in the remaining columns. We observe that better quantitative reasoning is significantly associated with higher net wealth accumulated and the probability of holding stocks. Meanwhile, we observe basically the same qualitative results as we have found in Section 3 while in some specifications (columns 10 and 17) we see some drop in statistical significance, which is mainly driven by the loss of observations rather than the controlling effects of the two newly added cognitive abilities.

## 5. Conclusion

Not planning for retirement finances is a worldwide phenomenon. And, even when individuals have planned for retirement, they still may improperly estimate the amount of savings needed for retirement and ultimately end up with inadequate finances in retirement. Utilizing survey data from urban households from a nationally representative sample in China, we study how cognitive constraints relate to the propensity to plan, retirement savings goals set, and downstream economic behaviors. Hereby, we advance existing literature in that we include more fine-grained measures

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wave (see introduction of cognition tests and Table B1 in Appendix B).

of cognitive constraints (basic and advanced financial literacy; verbal, math, quantitative reasoning, and memory cognition) at each stage of the planning and execution process in our empirical specifications to better understand which constraints are when relevant. Moreover, our data allows us to look into a so far important but not studied step of the planning process - specific monetary retirement savings goals that households set.

Consistent with that financial planning and plan execution are information intensive tasks, we find that different sub-dimensions of financial literacy and cognitive abilities play separate roles in explaining being a planner and setting savings goals, suggesting a multi-faceted retirement planning decision-making process. Advanced financial literacy relates to a higher probability of setting concrete savings goals, which we interpret to result from enhanced planning awareness and motivation. Both basic financial literacy, through better understanding of inflation, and verbal cognition, through improved information search and comprehension, are related to setting higher savings goals.

Moreover, our results demonstrate that being a planner, savings goals set, and cognitive constraints impact downstream economic behaviors. Specifically, downstream planning outcomes are conditional on the specific amount of savings goals, in that planners with a higher savings goal accumulate more wealth as well as invest more in risky assets and annuities. The economic importance of savings goals (in log form), in terms of a one standard deviation increase, is at least on par with, if not surpassing, that of the conventional predicting factors, that is, financial literacy and cognition.

Although we observe those positive effects of planning, financial literacy, and cognition on achieving higher savings, an important question is whether planning households (plan to) save enough. To get an approximate answer to this question, we perform some back-of-the-envelope calculations.<sup>30</sup> Hereby, we focus on the urban employees for which we have adequate information. First, we calculate the remaining

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<sup>30</sup> See, e.g., De Bresser and Knoef (2015) and Scholz et al. (2006) for extensive quantitative analyzes of the question of whether households save enough or are financially well-prepared for retirement.

life expectancy of a 60-year-old individual according to the procedure specified in Wilmoth et al. (2021), using an age-specific urban life table from 2015 (published in the China Population and Employment Statistics Yearbook 2016). The resulting remaining life expectancy is 25.7 years. The mean (median) savings goal for individual urban employees in our sample is about 42.8 (23.0) thousand yuan after adjusting for marital status (based on column 4 in Table 2). The average annual social pension for retired urban employees in 2014 is 24.6 thousand yuan according to the Annual Report on Social Insurance Development in China (2014) and the average annual salary for urban employees is 56.4 thousand yuan according to the annual China Statistical Yearbook. Based on those numbers, the expected replacement rate would increase through the savings goal from 43.6% to 73.2% (59.5% for the median). So economically, the mean savings goal set would result in achieving a substantial increase in retirement finances.

Regarding policy implications, our findings suggest that in order to improve retirement readiness more focus should be put on stimulating and enabling individuals to set concrete savings goals for retirement. Although there is controversy over the benefit and cost of retirement and financial education in enhancing retirement savings (Gomes et al., 2021), our findings suggest that more attention should be paid to the specific content of such education, for example, designing financial tasks about savings amount setting or teaching the fundamentals (such as the concept of inflation) and skills necessary for such goal setting. Alternatively (or as a substitute), it might be also beneficial to provide easy access to specialized tools and services that facilitate the estimation of savings needed for retirement, providing interventions that motivate concrete goal setting, and simplifying retirement related information and communication.

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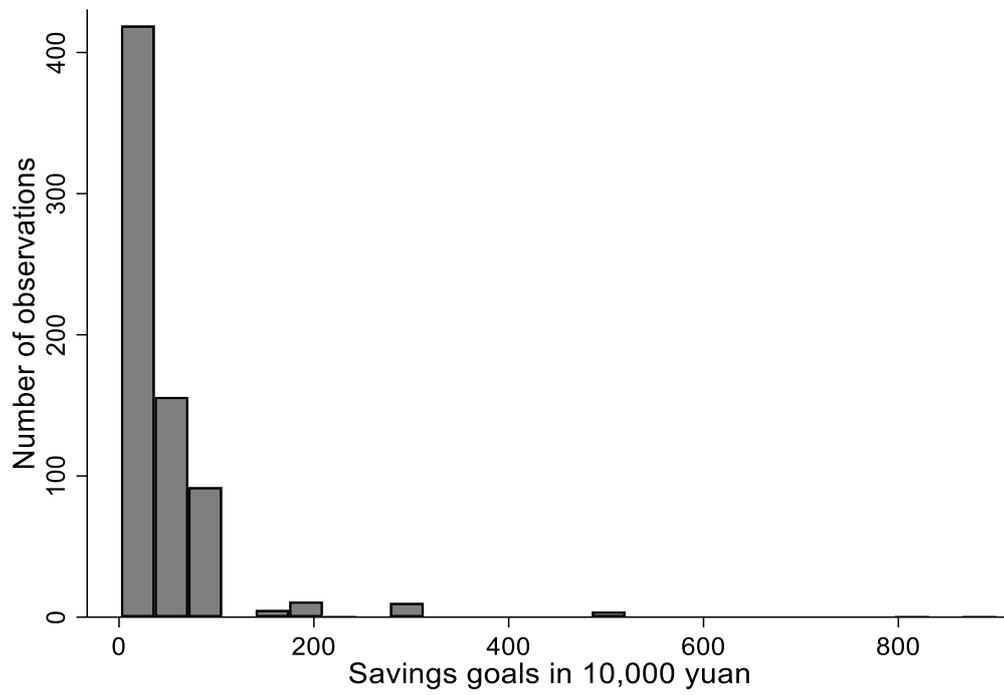
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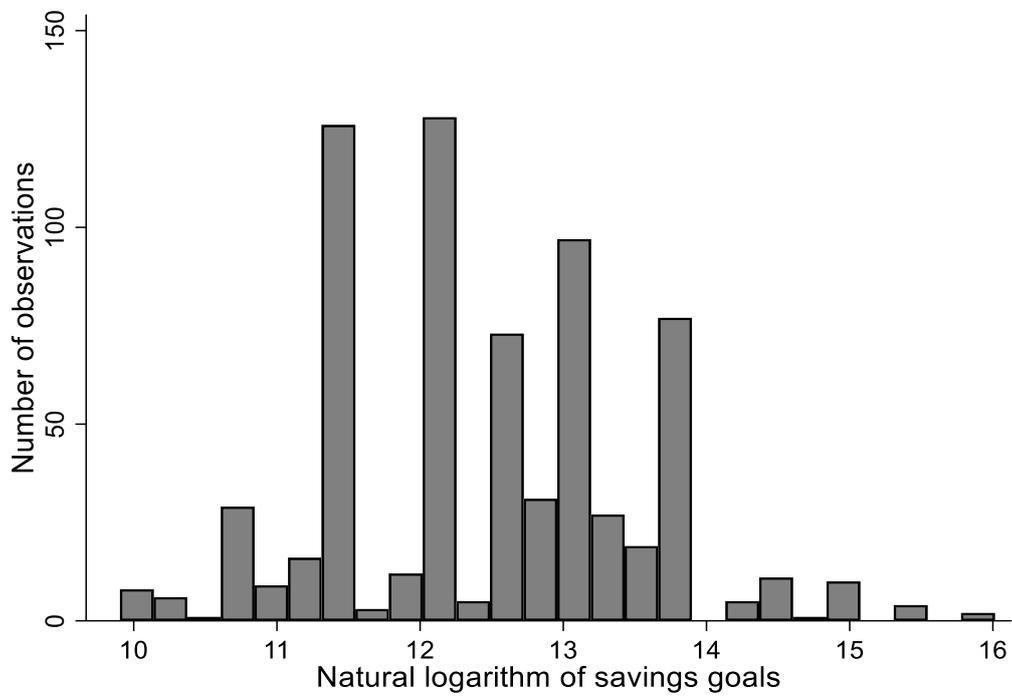
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## Figures and Tables



**Figure 1a Frequency of savings goals**



**Figure 1b Frequency of the natural logarithm transformation of savings goals**

This figure plots the savings goals as in the data (Figure 1a) and in the natural logarithm transformation (Figure 1b).

**Table 1 Definitions of main variables**

Variable	Definition	Planner analyses			Savings goal analyses		
		Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Planner	A binary variable taking the value of one if respondent or his/ her spouse has calculated saving needs for retirement, otherwise (a certain no or do not know) zero	2,231	0.31	0.46			
Savings goal	A continuous variable based on responses to the question (if Planner is equal to one): “What is the amount of money you or your spouse need to save for your retirement (in 10,000 yuan)?”				700	47.77	73.44
Net wealth	Net worth of household total wealth including gross financial assets, net housing wealth, other non-financial assets (land, durables, and productive fixed assets), less all non-housing debts (in 10,000 yuan)	2,182	66.16	105.25	688	64.26	96.60
Gross financial assets	The value of household gross financial assets including ash, deposits, stocks, mutual funds, government bonds, financial derivatives, other financial products like futures and options, and money lent to others (in 10,000 yuan)	2,209	8.18	20.14	692	8.33	18.08
Stock market participation	A binary variable taking the value of one if household is holding either stocks or mutual funds, otherwise zero	2,084	0.14	0.34	656	0.15	0.36
Financial investment holdings	A binary variable taking the value of one if household is holding either stocks, mutual funds, government bonds, financial derivatives, other financial products like futures and options, otherwise zero	2,084	0.15	0.35	656	0.17	0.38
Private annuity holdings	A binary variable taking the value of one if respondent is holding private annuity, otherwise zero	2,087	0.04	0.20	658	0.05	0.23
Basic FL	The first component of an iterated principal factor analysis for variables indicating correct answers and do-not-know answers of a series of 4 questions eliciting basic financial literacy, regarding interest rate of interest numeracy, interest compounding, inflation, and time value of money	2,231	0.00	1.03	700	0.12	0.92
Advanced FL	The first component of an iterated principal factor analysis for variables indicating correct answers and do-not-know answers of a series of 6 questions eliciting advanced financial literacy, regarding diversification, risk characteristics of different financial products, the definition of stocks, the characteristics of funds, the characteristics of banks’ wealth management products, and stock market’s function	2,231	-0.00	1.03	700	0.20	0.92
Vocabulary	Vocabulary score derived from 34 questions regarding verbal achievements	2,231	24.08	8.58	700	24.61	7.80
Numeracy	Numeracy score derived from 24 questions regarding mathematical achievements	2,231	11.29	6.13	700	11.47	6.00
Age	Respondent’s age in years	2,231	41.11	10.72	700	41.49	10.14

Female	A binary variable taking the value of one if respondent is female, otherwise zero	2,231	0.52	0.50	700	0.49	0.50
Marriage	A binary variable taking the value of one if respondent is married, otherwise zero	2,231	0.85	0.36	700	0.85	0.36
Middle school	A binary variable taking the value of one if respondent's highest education level is middle school, otherwise zero	2,231	0.28	0.45	700	0.30	0.46
High school	A binary variable taking the value of one if respondent's highest education level is high school, otherwise zero	2,231	0.26	0.44	700	0.27	0.44
College	A binary variable taking the value of one if respondent's highest education level is college and above (including bachelor's, master's, and doctor's degrees), otherwise zero	2,231	0.29	0.45	700	0.27	0.45
Work	A binary variable taking the value of one if respondent is working for pay, otherwise zero	2,231	0.82	0.38	700	0.84	0.36
Health	Self-reported health status, 1 = "unhealthy", 2 = "fair", 3 = "relatively healthy", 4 = "very healthy", 5 = "extremely healthy"	2,231	3.13	1.07	700	3.15	1.07
<i>Types of social or occupational pension coverage</i>							
#1 Pensions of government and public institutions	A binary variable taking the value of one if respondent is covered by pension of government and public institutions, otherwise zero	2,231	0.10	0.30	700	0.12	0.32
#2 Basic pension insurance	A binary variable taking the value of one if respondent is covered by basic pension insurance, otherwise zero	2,231	0.37	0.48	700	0.38	0.49
#3 Supplemental pension insurance of the firm	A binary variable taking the value of one if respondent is covered by supplemental pension insurance of the firm, otherwise zero	2,231	0.05	0.21	700	0.04	0.20
#4 Old rural pension insurance	A binary variable taking the value of one if respondent is covered by old rural pension insurance, otherwise zero	2,231	0.02	0.13	700	0.01	0.11
#5 New rural pension insurance	A binary variable taking the value of one if respondent is covered by new rural pension insurance, otherwise zero	2,231	0.12	0.32	700	0.11	0.32
#6 Urban resident pension insurance	A binary variable taking the value of one if respondent is covered by urban resident pension insurance, otherwise zero	2,231	0.10	0.30	700	0.11	0.32
#7 No social or	A binary variable taking the value of one if respondent is not covered by any type of social or occupational pensions,	2,231	0.33	0.47	700	0.31	0.46

occupational pension	otherwise zero						
Urban <i>hukou</i>	A binary variable taking the value of one if respondent's household registration status is urban, otherwise zero	2,231	0.72	0.45	700	0.73	0.44
Traditional view	Average scores of traditional view on parent-child relationships based on responses to the six statements: respectively "Children should treat their parents well however bad they are treated by parents", "Children should fulfill their parents' dreams instead of their own", "A boy should live with his parents after his marriage", "In order to continue the family lineage, women should give birth to at least a boy", "A man should strive for achievements to glorify their family name", and "Children should regularly visit their parents even though working away from home". 1-5 scale with increasing intensity, 1 = "strongly disagree", 5 = "strongly agree"	2,231	3.56	0.70	700	3.58	0.71
Family size	The number of cohabitating people in the household	2,231	3.33	1.45	700	3.28	1.33
Relative support	Relationships with relative based on responses to the question: "In the past 12 months, have your family had frequent interactions and contacts with non-cohabitating relatives (such as gatherings, visits, phone calls)?" 1 = "frequent interactions and contacts (once a month)", 2 = "occasional interactions and contacts (1-3 times every half year)", 3 = "rare interactions and contacts (1-2 times every year)", 4 = "no interaction or contact"; reverse coded	2,231	3.46	0.72	700	3.46	0.71
Income	Annual income of household (in 10,000 yuan)	2,231	7.47	11.50	700	6.96	8.83
Financial difficulty	A binary variable taking the value of one if financial difficulty is the main difficulty the household is facing, otherwise zero	2,231	0.36	0.48	700	0.40	0.49
Severity	Severity perception of social security based on responses to the question: "In general, how do you think is the severity of the social security problem in China?" 0-10 scale with increasing intensity, 1 = "not severe", 10 = "very severe"	2,231	6.81	2.36	700	6.82	2.38
Patience	Time preference based on responses to the statement: "I intend to live in the present more and do not consider the future." 1 = "totally inapplicable", 2 = "somewhat inapplicable", 3 = "generally applicable", 4 = "somewhat applicable", 5 = "totally applicable"; reverse coded	2,231	3.41	1.28	700	3.53	1.25
Risk aversion	Attitudes toward risky investment based on responses to the question: "If your family invest/In investment, what kind of risk are you willing to take?" 1 = "high risk and high return", 2 = "moderate risk and steady return", 3 = "low risk and low return", 4 = "unwilling to take any investment risk"	2,231	2.82	0.94	700	2.78	0.90
Present bias	Average scores based on responses to the two statements: respectively "I will consider affordability when I buy things" and "I spend according on my income in my daily life". 1 = "totally inapplicable", 2 = "somewhat inapplicable", 3 =	2,231	1.87	0.78	700	1.87	0.76

“generally applicable”, 4 = “somewhat applicable”, 5 = “totally applicable”; reverse coded

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This table presents variable definitions and descriptive statistics.

**Table 2 The determinants of being a planner and savings goal**

	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	OLS
	Planner	Planner	Ln (Savings goal)	Ln (Savings goal)
Basic FL	0.012 (0.011)	0.009 (0.011)	0.107** (0.047)	0.097** (0.047)
Advanced FL	0.079*** (0.012)	0.076*** (0.012)	-0.047 (0.048)	-0.061 (0.048)
Vocabulary	0.001 (0.002)	0.001 (0.002)	0.018** (0.007)	0.016** (0.007)
Numeracy	0.001 (0.002)	0.000 (0.002)	-0.004 (0.008)	-0.005 (0.008)
<i>Demographic and socio-economic characteristics</i>				
Age	0.003** (0.001)	0.003*** (0.001)	-0.004 (0.005)	-0.002 (0.005)
Female	-0.030 (0.021)	-0.025 (0.021)	-0.168** (0.077)	-0.132* (0.076)
Marriage	-0.010 (0.030)	-0.010 (0.030)	0.243** (0.108)	0.267** (0.106)
Middle school	-0.021 (0.030)	-0.023 (0.030)	0.005 (0.119)	-0.005 (0.119)
High school	-0.049 (0.034)	-0.048 (0.034)	0.123 (0.140)	0.143 (0.139)
College	-0.112*** (0.039)	-0.116*** (0.039)	0.358** (0.151)	0.360** (0.150)
Work	0.037 (0.027)	0.036 (0.027)	0.045 (0.110)	0.033 (0.109)
Health	0.011 (0.009)	0.010 (0.009)	-0.098*** (0.037)	-0.086** (0.036)
Urban <i>Hukou</i>	-0.032 (0.026)	-0.027 (0.026)	-0.013 (0.112)	0.015 (0.112)
Traditional view	0.038*** (0.015)	0.041*** (0.015)	-0.059 (0.056)	-0.061 (0.055)
Family size	0.006 (0.007)	0.006 (0.007)	-0.042 (0.034)	-0.040 (0.034)
Relative support	-0.004 (0.013)	-0.005 (0.013)	-0.052 (0.061)	-0.053 (0.060)
Ln (Income)	-0.001 (0.010)	-0.002 (0.010)	0.122** (0.051)	0.105** (0.052)
Financial difficulty	0.068*** (0.021)	0.068*** (0.021)	-0.051 (0.076)	-0.048 (0.076)
Severity	-0.002	-0.002	0.035**	0.037**

	(0.004)	(0.004)	(0.016)	(0.016)
<i>Preferences and behavioral traits</i>				
Patience		0.019** (0.007)		0.074** (0.029)
Risk aversion		-0.015 (0.011)		-0.091** (0.043)
Present bias		0.003 (0.012)		0.101** (0.048)
Types of social or occupational pension coverage FEs	✓	✓	✓	✓
Province FEs	✓	✓	✓	✓
Observations	2,231	2,231	700	700

This table presents the results from OLS regressions of being a planner (columns 1 and 2) and savings goal (columns 3 and 4) on both basic and advanced financial literacy and cognitive abilities with the expansion of the set of control variables. Ln (X) is the natural logarithm transformation of X. Heteroskedasticity-robust standard errors are given in parentheses. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 3 Being a planner, savings goal, and wealth accumulation**

	(1)	(2)	(3)	(4)	(5)	(6)
	Median	Median	Median	Median	Median	Median
	Net wealth	Net wealth	Net wealth	Gross financial assets	Gross financial assets	Gross financial assets
Planner	2.350*			0.345		
	(1.347)			(0.229)		
Ln (Savings goal)		3.823***			0.598***	
		(1.242)			(0.204)	
Planner: Low			1.259			0.020
			(1.518)			(0.262)
Planner: High			6.001**			0.934**
			(2.492)			(0.420)
Basic FL	1.379**	4.622***	1.420**	0.154*	0.458**	0.175*
	(0.587)	(1.018)	(0.607)	(0.088)	(0.195)	(0.096)
Advanced FL	0.959	-0.281	0.880	0.248**	0.013	0.263**
	(0.614)	(1.153)	(0.760)	(0.107)	(0.264)	(0.121)
Vocabulary	0.074	-0.023	0.082	0.025*	-0.017	0.020
	(0.079)	(0.182)	(0.091)	(0.014)	(0.036)	(0.013)
Numeracy	0.081	-0.163	0.037	0.045*	0.047	0.051**
	(0.135)	(0.244)	(0.151)	(0.025)	(0.043)	(0.026)
Other controls	✓	✓	✓	✓	✓	✓
Province FEs	✓	✓	✓	✓	✓	✓
Observations	2,182	688	2,182	2,209	692	2,209

This table presents the results from median regressions of net wealth (columns 1 to 3) and gross financial assets (columns 4 to 6) on being a planner and savings goal. Planner: Low (High) is a binary variable taking the value of one if respondent or his/ her spouse has calculated saving needs for retirement and their savings goal are equal to or below (above) 300 thousand yuan, otherwise zero. Other controls include Age, Female, Marriage, Middle school, High school, College, Work, Health, Types of social or occupational pension coverage, Urban *hukou*, Traditional view, Family size, Relative support, Ln (Income), Financial difficulty, Severity, Patience, Risk aversion, and Present bias. Variables are defined in Table 1. Ln (X) is the natural logarithm transformation of X. Heteroskedasticity-robust standard errors are given in parentheses. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 4 Being a planner, savings goal, and risky asset holdings**

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
	Stock	Stock	Stock	Financial	Financial	Financial
	market	market	market	investment	investment	investment
	participation	participation	participation	holdings	holdings	holdings
Ln (Net wealth excl.)	0.024*** (0.004)	0.021** (0.008)	0.024*** (0.004)	0.026*** (0.004)	0.027*** (0.009)	0.026*** (0.004)
Planner	0.010 (0.016)			0.023 (0.017)		
Ln (Savings goal)		0.024* (0.014)			0.021 (0.014)	
Planner: Low			-0.015 (0.018)			-0.007 (0.018)
Planner: High			0.044* (0.024)			0.064** (0.025)
Basic FL	-0.001 (0.007)	0.022* (0.012)	-0.001 (0.007)	-0.002 (0.007)	0.024* (0.013)	-0.002 (0.007)
Advanced FL	0.055*** (0.008)	0.056*** (0.016)	0.056*** (0.008)	0.056*** (0.008)	0.060*** (0.016)	0.058*** (0.008)
Vocabulary	0.000 (0.001)	-0.001 (0.002)	0.000 (0.001)	0.000 (0.001)	-0.000 (0.002)	0.000 (0.001)
Numeracy	0.001 (0.002)	-0.001 (0.003)	0.001 (0.002)	0.001 (0.002)	0.000 (0.003)	0.001 (0.002)
Other controls	✓	✓	✓	✓	✓	✓
Province FEs	✓	✓	✓	✓	✓	✓
Observations	2,084	656	2,084	2,084	656	2,084

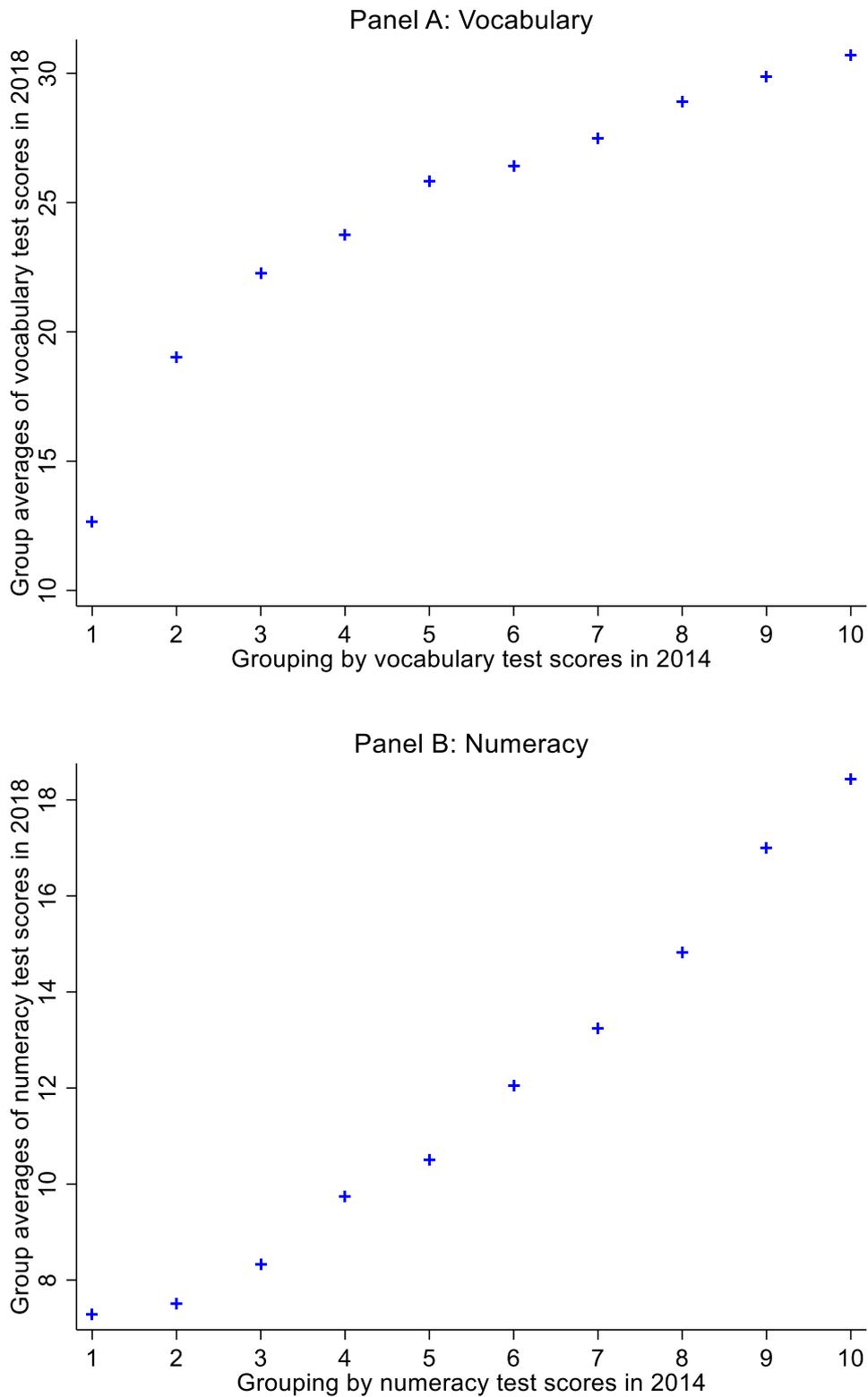
This table presents the results from OLS regressions of stock market participation (columns 1 to 3) and financial investment holdings (columns 4 to 6) on being a planner and savings goal. Planner: Low (High) is a binary variable taking the value of one if respondent or his/ her spouse has calculated saving needs for retirement and their savings goal are equal to or below (above) 300 thousand yuan, otherwise zero. We add the natural logarithm of net wealth (excluding the value of all financial products including stocks, mutual funds, government bonds, financial derivatives, and other financial products) from the 2014 wave in the regressions. Other controls include Age, Female, Marriage, Middle school, High school, College, Work, Health, Types of social or occupational pension coverage, Urban *hukou*, Traditional view, Family size, Relative support, Ln (Income), Financial difficulty, Severity, Patience, Risk aversion, and Present bias. Variables are defined in Table 1. Ln (X) is the natural logarithm transformation of X. Heteroskedasticity-robust standard errors are given in parentheses. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 5 Being a planner, savings goal, and private annuity holdings**

	(1)	(2)	(3)
	OLS	OLS	OLS
	Private annuity holdings	Private annuity holdings	Private annuity holdings
Ln (Net wealth)	0.009*** (0.003)	0.012* (0.006)	0.009*** (0.003)
Planner	0.012 (0.011)		
Ln (Savings goal)		0.030*** (0.010)	
Planner: Low			-0.006 (0.011)
Planner: High			0.036* (0.019)
Basic FL	0.006 (0.005)	-0.003 (0.012)	0.006 (0.005)
Advanced FL	0.011* (0.006)	0.017 (0.012)	0.012** (0.006)
Vocabulary	0.000 (0.001)	-0.000 (0.002)	0.000 (0.001)
Numeracy	-0.002 (0.001)	-0.003 (0.002)	-0.002 (0.001)
Other controls	✓	✓	✓
Province FEs	✓	✓	✓
Observations	2,087	658	2,087

This table presents the results from OLS regressions of private annuity holdings on being a planner and savings goal. Planner: Low (High) is a binary variable taking the value of one if respondent or his/ her spouse has calculated saving needs for retirement and their savings goal are equal to or below (above) 300 thousand yuan, otherwise zero. We add the natural logarithm of net wealth from the 2014 wave in the regressions. Other controls include Age, Female, Marriage, Middle school, High school, College, Work, Health, Types of social or occupational pension coverage, Urban *hukou*, Traditional view, Family size, Relative support, Ln (Income), Financial difficulty, Severity, Patience, Risk aversion, and Present bias. Variables are defined in Table 1. Ln (X) is the natural logarithm transformation of X. Heteroskedasticity-robust standard errors are given in parentheses. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

## Appendix A: Additional Figures and Tables



**Figure A1 Temporal rank-order stability of the test scores of cognitive abilities**

This figure plots the group averages of test scores for each cognitive test in the 2018 wave based on ten groups sorted evenly according to the test scores in the 2014 wave using the panel sample.

**Table A1 Financial literacy questions: wording and summary statistics (in %)**

Questions	Non-retired sample (2,231 obs.)		
	Correct	Incorrect	Do not know
<i>Basic financial literacy questions</i>			
(1) <i>Interest numeracy</i> : Suppose you have a one-year fixed deposit of 10,000 yuan and the annual interest rate is 3%. If you do not withdraw within this period, how much money will you get on the due date? (#10300 yuan/ More than 10300 yuan/ Less than 10300 yuan)	49.2	33.3	17.4
(2) <i>Interest compounding</i> : After the due date of deposit in the above question, if you continue to save the money as one-year fixed deposit and the annual interest rate is 3%, how much money will you have in this account after one year, including the principal and interests? (10600 yuan/ #More than 10600 yuan/ Less than 10600 yuan)	56.7	24.2	19.0
(3) <i>Inflation</i> : If the annual interest rate of your savings account is 3%, and the inflation rate is 5%, how many goods you can buy using your savings in this account after one year? (More than today/ The same as today/ #Less than today)	63.0	19.1	17.9
(4) <i>Time value of money</i> : Suppose Zhang San inherits 100,000 yuan today, and Li Si will inherit 100,000 yuan three years later. Who has a higher value of inheritance? (#Zhang San/ Li Si/ The same)	75.1	13.0	11.9
<i>Advanced financial literacy questions</i>			
(5) <i>Diversification</i> : In general, investing in a single stock is less risky than investing in a stock fund. (True/ #False)	40.6	23.4	36.0
(6) <i>Risk properties of different financial products</i> : Generally speaking, which of the following investments has the highest risk? (Bank deposits/ Government bonds/ #Stocks/ Funds)	74.3	10.1	15.6
(7) <i>Definition of stocks</i> : What does it mean if you purchase stocks of some company? (No matter you hold these stocks for a short term or long term, you lend the money to the company anyway/ #No matter you hold these stocks for a short term or long term, you are the stockholder of the company anyway/ You are the stockholder of a company when you hold its stocks for a long term, while you lend the money to a company when you hold its stocks for a short term/ None of the above is correct)	19.5	46.8	33.8
(8) <i>Characteristics of funds</i> : Which of the following statements is correct about funds? (Funds with low process (low NAV per unit) has a better future performance/ #In general, a single fund can invest in several assets, for example, in both stocks and bonds/ In general, funds are able to provide a guaranteed rate of return based on past performance/ None of the above is correct)	15.6	35.1	49.2
(9) <i>Characteristics of banks' wealth management products</i> : Which of the following statements is correct about banks' wealth management products? (#Banks' wealth management products, like other risky assets, are also possible to suffer from loss/ Banks' wealth management products is as safe as bank deposits, at least not to lose money/ The expected return of banks' wealth management products is the actual return / None of the above is correct)	37.3	32.9	29.8
(10) <i>Function of the stock market</i> : Which of the following statements is correct about the core function of the stock market? (The stock market is helpful in predicting the returns of stocks/ The stock market increases the prices of stocks/ #The stock market helps bring together buyers and sellers of stocks/ None of the above is correct)	35.5	24.2	40.4

This table presents wording and summary statistics of financial literacy questions. Choices are given in parentheses and # indicates the correct response. "Do not know" is an alternative choice for all questions.

**Table A2 Correlations between variables of interest**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 Planner	1.00																
2 Ln (Savings goal)	/	1.00															
3 Net wealth	-0.01	0.29***	1.00														
4 Gross financial assets	0.01	0.26***	0.53***	1.00													
5 Stock market participation	0.03	0.23***	0.31***	0.43***	1.00												
6 Financial investment holdings	0.04*	0.25***	0.32***	0.43***	0.95***	1.00											
7 Private annuity holdings	0.04*	0.16***	0.15***	0.10***	0.16***	0.15***	1.00										
8 Basic FL	0.08***	0.24***	0.16***	0.16***	0.19***	0.21***	0.09***	1.00									
9 Advanced FL	0.13***	0.22***	0.18***	0.21***	0.28***	0.30***	0.10***	0.56***	1.00								
10 Vocabulary	0.04**	0.28***	0.12***	0.15***	0.16***	0.18***	0.05**	0.40***	0.44***	1.00							
11 Numeracy	0.02	0.26***	0.17***	0.16***	0.18***	0.20***	0.03	0.37***	0.44***	0.62***	1.00						
12 Age	0.02	-0.15***	0.02	0.00	0.04*	0.02	-0.04*	-0.25***	-0.28***	-0.36***	-0.32***	1.00					
13 Female	-0.04*	-0.11***	-0.05**	-0.05**	-0.03	-0.04**	0.00	-0.11***	-0.13***	-0.03	-0.09***	-0.09***	1.00				
14 Middle school	0.03	-0.16***	-0.08***	-0.09***	-0.10***	-0.11***	-0.03	-0.06***	-0.10***	-0.14***	-0.22***	0.08***	0.01	1.00			
15 High school	0.01	0.05	-0.00	-0.03	0.02	0.01	0.04*	0.04*	0.04*	0.15***	0.06***	-0.02	-0.03	-0.37***	1.00		
16 College	-0.02	0.29***	0.17***	0.19***	0.19***	0.22***	0.03	0.29***	0.37***	0.37***	0.48***	-0.28***	-0.04**	-0.39***	-0.38***	1.00	
17 Urban <i>Hukou</i>	0.02	0.14***	0.16***	0.09***	0.18***	0.19***	0.01	0.10***	0.18***	0.17***	0.14***	0.16***	0.00	-0.10***	0.09***	0.20***	1.00

This table presents pairwise correlations of two measures regarding the retirement planning process, three types of economic outcomes, cognitive measures, and several demographic and socio-economic variables using all available observations. Ln (X) is the natural logarithm transformation of X. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table A3 The determinants of being a planner and savings goal: The separate roles of financial literacy and cognitive abilities and excluding education level dummies**

	(1)	(2)
	OLS	OLS
	Planner	Ln (Savings goal)
Panel A: Only including basic financial literacy		
Basic FL	0.038*** (0.010)	0.086** (0.044)
Panel B: Only including advanced financial literacy		
Advanced FL	0.082*** (0.011)	-0.016 (0.044)
Panel C: Only including vocabulary test score		
Vocabulary	0.003** (0.001)	0.015** (0.006)
Panel D: Only including numeracy test score		
Numeracy	0.004* (0.002)	0.002 (0.007)
Panel E: Excluding all measures of financial literacy and cognitive abilities		
Middle school	0.011 (0.030)	0.084 (0.115)
High school	-0.003 (0.032)	0.267** (0.130)
College	-0.047 (0.037)	0.482*** (0.136)
Panel F: Excluding education level dummies		
Basic FL	0.009 (0.011)	0.101** (0.047)
Advanced FL	0.072*** (0.012)	-0.044 (0.048)
Vocabulary	0.001 (0.002)	0.017** (0.007)
Numeracy	-0.002 (0.002)	0.003 (0.008)
Panel G: Including the natural logarithm of net wealth from the 2012 wave		
Ln (Net wealth (2012))	0.018** (0.008)	0.083*** (0.029)
Basic FL	0.008 (0.012)	0.092* (0.051)
Advanced FL	0.077*** (0.013)	-0.072 (0.051)
Vocabulary	0.000 (0.002)	0.016** (0.007)
Numeracy	-0.000 (0.002)	-0.006 (0.009)

Other controls (education level dummies are excluded in panels E and F)	✓	✓
Province FEs	✓	✓
Observations	2,231 (1,943 in panel G)	700 (612 in panel G)

This table presents the results from OLS regressions of being a planner (column 1) and savings goal (column 3) on both basic and advanced financial literacy and cognitive abilities. In panel A to D, we include separately Basic FL, Advanced FL, Vocabulary, and Numeracy. In panel E, we exclude all measures of financial literacy and cognitive abilities, while in panel F we exclude three dummies of education level. In panel G, we further control for the natural logarithm of net wealth from the 2012 wave. Other controls include Age, Female, Marriage, Middle school, High school, College, Work, Health, Types of social or occupational pension coverage, Urban *hukou*, Traditional view, Family size, Relative support, Ln (Income), Financial difficulty, Severity, Patience, Risk aversion, and Present bias (education level dummies are not included in panels E and F). Variables are defined in Table 1. Ln (X) is the natural logarithm transformation of X. Heteroskedasticity-robust standard errors are given in parentheses. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table A4 The determinants of being a planner and savings goal: Exploring potential mechanisms**

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	OLS	OLS
	Planning awareness	Planner	Internet usage	Ln (Savings goal)	Ln (Savings goal)
Planning awareness		0.038*** (0.012)			
Internet usage				0.178* (0.095)	
Basic FL	0.013 (0.028)	0.015 (0.013)	-0.006 (0.019)	0.098** (0.047)	
Advanced FL	0.181*** (0.028)	0.056*** (0.014)	0.033 (0.022)	-0.067 (0.048)	-0.060 (0.049)
Vocabulary	-0.001 (0.004)	0.001 (0.002)	0.009*** (0.003)	0.014** (0.007)	0.017** (0.007)
Numeracy	-0.005 (0.004)	0.001 (0.002)	-0.001 (0.003)	-0.005 (0.008)	-0.006 (0.008)
Interest numeracy: Right					-0.021 (0.082)
Interest compounding: Right					-0.012 (0.091)
Inflation: Right					0.227** (0.101)
Time value of money: Right					0.078 (0.115)
Interest numeracy: DK					-0.158 (0.162)
Interest compounding: DK					0.052 (0.162)
Inflation: DK					-0.070 (0.155)
Time value of money: DK					0.137 (0.184)
Other controls	✓	✓	✓	✓	✓
Province FEs	✓	✓	✓	✓	✓
Observations	1,897	1,897	700	700	700

This table presents the results from OLS regressions examining the potential mechanisms of cognitive constraints on being a planner and savings goal. Planning awareness is constructed as the average agreement level from responses to two statements regarding the extent to which the respondent pays very close attention to their financial situation and has the habit of collecting product information and compare various types of products when choosing financial products (e.g., stocks, bonds, funds, options, futures, and foreign exchanges), with a 0-5 scale ranging from “totally inapplicable” to “totally applicable”. Internet usage is a binary variable taking the value of one if respondent uses the Internet, otherwise zero. Interest compounding (Interest compounding, Inflation, Time value of money):

Right (DK) is a binary variable indicating whether the respondent's answer to the question of interest compounding (Interest compounding, Inflation, Time value of money) is right (DK). Other controls include Age, Female, Marriage, Middle school, High school, College, Work, Health, Types of social or occupational pension coverage, Urban *hukou*, Traditional view, Family size, Relative support, Ln (Income), Financial difficulty, Severity, Patience, Risk aversion, and Present bias. Variables are defined in Table 1. Ln ( $X$ ) is the natural logarithm transformation of  $X$ . Heteroskedasticity-robust standard errors are given in parentheses. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table A5 Being a planner, savings goal, and wealth accumulation: Other measures of wealth**

	(1)	(2)	(3)	(4)	(5)	(6)
	Median	Median	Median	Median	Median	Median
	Net wealth	Net wealth	Net wealth	Net housing	Net housing	Net housing
	(excluding	(excluding	(excluding	wealth	wealth	wealth
	gross	gross	gross			
	financial	financial	financial			
	assets)	assets)	assets)			
Planner	2.263**			0.785		
	(1.133)			(0.951)		
Ln (Savings goal)		2.574**			2.933***	
		(1.134)			(0.959)	
Planner: Low			0.595			-0.561
			(1.349)			(1.105)
Planner: High			4.928**			3.593**
			(2.013)			(1.622)
Basic FL	1.271***	2.895***	1.391***	1.011**	3.791***	1.189***
	(0.452)	(0.988)	(0.499)	(0.446)	(1.006)	(0.451)
Advanced FL	0.201	-1.633	-0.040	0.463	-1.599	0.447
	(0.591)	(1.195)	(0.585)	(0.484)	(1.161)	(0.535)
Vocabulary	0.018	-0.013	0.049	0.040	0.078	0.042
	(0.074)	(0.161)	(0.074)	(0.071)	(0.131)	(0.070)
Numeracy	-0.021	-0.074	-0.022	0.009	-0.112	0.038
	(0.121)	(0.236)	(0.117)	(0.096)	(0.209)	(0.101)
Other controls	✓	✓	✓	✓	✓	✓
Province FEs	✓	✓	✓	✓	✓	✓
Observations	2,182	688	2,182	2,224	699	2,224

This table presents the results from median regressions of net wealth (excluding gross financial assets) (columns 1 to 3) and net housing wealth (columns 4 to 6) on being a planner and savings goal. Net wealth (excluding gross financial assets) is constructed by subtracting gross financial assets from net wealth. Net housing wealth is constructed by subtracting total housing debts from gross housing assets. Planner: Low (High) is a binary variable taking the value of one if respondent or his/ her spouse has calculated saving needs for retirement and their savings goal are equal to or below (above) 300 thousand yuan, otherwise zero. Other controls include Age, Female, Marriage, Middle school, High school, College, Work, Health, Types of social or occupational pension coverage, Urban *hukou*, Traditional view, Family size, Relative support, Ln (Income), Financial difficulty, Severity, Patience, Risk aversion, and Present bias. Variables are defined in Table 1. Ln (X) is the natural logarithm transformation of X. Heteroskedasticity-robust standard errors are given in parentheses. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table A6 Being a planner, savings goal, and wealth accumulation: A change model**

	(1)	(2)	(3)	(4)	(5)	(6)
	Median	Median	Median	Median	Median	Median
	Net wealth	Net wealth	Net wealth	Gross financial assets	Gross financial assets	Gross financial assets
Net wealth (2012)	0.701*** (0.055)	0.750*** (0.037)	0.703*** (0.055)	0.545*** (0.077)	0.674*** (0.113)	0.545*** (0.075)
Planner	-0.242 (0.887)			0.311** (0.149)		
Ln (Savings goal)		2.329*** (0.780)			0.490** (0.219)	
Planner: Low			-1.815* (0.982)			0.101 (0.169)
Planner: High			2.908 (2.010)			0.939*** (0.344)
Basic FL	0.636 (0.431)	0.809 (1.152)	0.785* (0.418)	0.135** (0.065)	0.146 (0.200)	0.119 (0.075)
Advanced FL	0.497 (0.529)	-1.473 (1.195)	0.279 (0.494)	0.090 (0.080)	-0.068 (0.228)	0.117 (0.092)
Vocabulary	0.037 (0.061)	-0.072 (0.158)	-0.008 (0.057)	0.001 (0.009)	0.012 (0.028)	0.002 (0.009)
Numeracy	0.048 (0.083)	-0.065 (0.171)	0.116 (0.102)	0.034* (0.018)	-0.011 (0.044)	0.034* (0.019)
Other controls	✓	✓	✓	✓	✓	✓
Province FEs	✓	✓	✓	✓	✓	✓
Observations	1,953	623	1,953	2,015	635	2,015

This table presents the results from median regressions of net wealth (columns 1 to 3) and gross financial assets (columns 4 to 6) on being a planner and savings goal while controlling for net wealth from the 2012 wave. Planner: Low (High) is a binary variable taking the value of one if respondent or his/ her spouse has calculated saving needs for retirement and their savings goal are equal to or below (above) 300 thousand yuan, otherwise zero. Other controls include Age, Female, Marriage, Middle school, High school, College, Work, Health, Types of social or occupational pension coverage, Urban *hukou*, Traditional view, Family size, Relative support, Ln (Income), Financial difficulty, Severity, Patience, Risk aversion, and Present bias. Variables are defined in Table 1. Ln (X) is the natural logarithm transformation of X. Heteroskedasticity-robust standard errors are given in parentheses. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table A7 Empirical results associated with being a planner excluding “do not know” answers**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	OLS	Median	Median	Median	Median	OLS	OLS	OLS	OLS	OLS	OLS
	Planner	Net wealth	Net wealth	Gross financial assets	Gross financial assets	Stock market participation	Stock market participation	Financial investment holdings	Financial investment holdings	Private annuity holdings	Private annuity holdings
Ln (Net wealth (excl.))						0.023***	0.022***	0.026***	0.025***	0.011***	0.011***
Planner		2.973**		0.366*		(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
		(1.302)		(0.218)		(0.016)	(0.019)	(0.032*)	(0.019)	(0.016)	(0.012)
Planner: Low			1.362		0.121		-0.007		0.005		-0.001
			(1.549)		(0.229)		(0.020)		(0.021)		(0.012)
Planner: High			7.357***		1.284***		0.046*		0.069**		0.039**
			(2.189)		(0.371)		(0.026)		(0.027)		(0.020)
Basic FL	0.017	2.026***	1.987***	0.256**	0.205**	0.001	0.000	0.001	0.000	0.004	0.004
	(0.016)	(0.753)	(0.735)	(0.114)	(0.100)	(0.008)	(0.008)	(0.009)	(0.009)	(0.006)	(0.006)
Advanced FL	0.072***	0.259	0.397	0.104	0.167	0.048***	0.050***	0.049***	0.051***	0.012*	0.013*
	(0.017)	(0.750)	(0.815)	(0.140)	(0.122)	(0.010)	(0.010)	(0.010)	(0.010)	(0.007)	(0.007)
Vocabulary	0.003*	0.250**	0.174*	0.037**	0.032**	-0.001	-0.001	-0.001	-0.001	0.000	0.000
	(0.002)	(0.105)	(0.099)	(0.017)	(0.015)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Numeracy	0.002	-0.099	-0.105	0.062**	0.056**	0.001	0.001	0.002	0.002	-0.002	-0.002
	(0.003)	(0.163)	(0.172)	(0.027)	(0.025)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Other controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Province FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	1,466	1,442	1,442	1,454	1,454	1,375	1,375	1,375	1,375	1,378	1,378

This table presents the results from OLS regressions of being a planner (column 1) on both basic and advanced financial literacy and four types of cognitive abilities, median regressions of net

wealth (columns 2 and 3) and gross financial assets (columns 4 and 5) as well as OLS regressions of stock market participation (columns 6 and 7), financial investment holdings (columns 8 and 9), and private annuity holdings (columns 10 and 11) on being a planner excluding do-not-know answers to the question regarding being a planner. Planner: Low (High) is a binary variable taking the value of one if respondent or his/ her spouse has calculated saving needs for retirement and their savings goal are equal to or below (above) 300 thousand yuan, otherwise zero. We add the natural logarithm of net wealth (excluding the value of all financial products including stocks, mutual funds, government bonds, financial derivatives, and other financial products) from the 2014 wave in columns 10 and 11 (in columns 6 to 9). Other controls include Age, Female, Marriage, Middle school, High school, College, Work, Health, Types of social or occupational pension coverage, Urban *hukou*, Traditional view, Family size, Relative support, Ln (Income), Financial difficulty, Severity, Patience, Risk aversion, and Present bias. Variables are defined in Table 1. Ln (X) is the natural logarithm transformation of X. Heteroskedasticity-robust standard errors are given in parentheses. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table A8 Exploring other types of cognitive constraints in retirement planning**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
	OLS	OLS	Median	Median	Median	Median	Median	Median	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
	Planner	Ln (Savings goal)	Net wealth	Net wealth	Net wealth	Gross financial assets	Gross financial assets	Gross financial assets	Stock market participation	Stock market participation	Stock market participation	Financial investment holdings	Financial investment holdings	Financial investment holdings	Private annuity holdings	Private annuity holdings	Private annuity holdings
Ln (Net wealth (excl.))									0.029***	0.025***	0.029***	0.032***	0.032***	0.031***	0.012***	0.016***	0.012***
Planner			3.070**			0.188			0.011			0.025			0.004		
			(1.356)			(0.229)			(0.019)			(0.019)			(0.013)		
Ln (Savings goal)				4.254***			0.643**			0.023			0.026			0.025**	
				(1.405)			(0.292)			(0.016)			(0.016)			(0.011)	
Planner: Low					0.352			-0.210			-0.015			-0.012			-0.008
					(1.889)			(0.299)			(0.021)			(0.021)			(0.012)
Planner: High					9.817***			1.052*			0.047*			0.076***			0.021
					(2.676)			(0.559)			(0.028)			(0.029)			(0.021)
Basic FL	0.016	0.089*	1.062*	2.596*	1.346*	0.225**	0.502*	0.150	-0.002	0.013	-0.003	-0.004	0.015	-0.004	0.003	-0.010	0.003
	(0.012)	(0.052)	(0.612)	(1.466)	(0.791)	(0.089)	(0.290)	(0.101)	(0.008)	(0.015)	(0.008)	(0.008)	(0.015)	(0.008)	(0.006)	(0.013)	(0.006)
Advanced FL	0.078***	-0.042	1.167	-0.049	1.285*	0.341***	-0.293	0.395***	0.059***	0.063***	0.060***	0.059***	0.066***	0.061***	0.013**	0.019	0.014**
	(0.013)	(0.055)	(0.735)	(1.745)	(0.774)	(0.114)	(0.278)	(0.130)	(0.009)	(0.019)	(0.009)	(0.009)	(0.019)	(0.009)	(0.007)	(0.014)	(0.007)
Vocabulary	0.001	0.026***	-0.031	0.195	-0.033	-0.007	-0.013	-0.005	-0.001	-0.003	-0.001	-0.001	-0.002	-0.001	-0.001	0.000	-0.001
	(0.002)	(0.008)	(0.110)	(0.244)	(0.110)	(0.017)	(0.041)	(0.018)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Numeracy	-0.001	-0.010	0.260*	-0.250	0.216	0.059**	0.016	0.061**	-0.000	-0.003	0.000	-0.000	-0.002	0.000	-0.002	-0.003	-0.002
	(0.002)	(0.009)	(0.134)	(0.349)	(0.160)	(0.028)	(0.044)	(0.027)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)	(0.001)
Quantitative reasoning	0.001**	-0.000	0.046***	0.086*	0.049**	-0.000	0.010	-0.000	0.000*	0.001	0.000*	0.000	0.001	0.000	0.000	0.000	0.000
	(0.000)	(0.002)	(0.017)	(0.046)	(0.022)	(0.003)	(0.007)	(0.004)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)

Memory	-0.003 (0.004)	0.022 (0.017)	-0.009 (0.206)	-0.770 (0.486)	0.071 (0.242)	0.047 (0.042)	0.142 (0.092)	0.022 (0.046)	-0.002 (0.003)	0.001 (0.006)	-0.002 (0.003)	-0.002 (0.003)	-0.001 (0.006)	-0.002 (0.003)	0.003 (0.002)	-0.003 (0.004)	0.003 (0.002)
Other controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Province FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	1,797	573	1,752	562	1,752	1,777	566	1,777	1,677	541	1,677	1,677	541	1,677	1,678	541	1,678

This table presents the results from OLS regressions of being a planner (column 1) and savings goal (column 2) on both basic and advanced financial literacy and four types of cognitive abilities, median regressions of net wealth (columns 3 to 5) and gross financial assets (columns 6 to 8) as well as OLS regressions of stock market participation (columns 9 to 11), financial investment holdings (columns 12 to 14), and private annuity holdings (columns 15 to 17) on being a planner and savings goal. Quantitative reasoning is the test score of number series adjusted by Rasch item response theory (IRT) model, and Memory is the test score of both immediate and delayed word recall. We average the test scores of Quantitative reasoning and Memory in the 2012, 2016, and 2020 waves. Planner: Low (High) is a binary variable taking the value of one if respondent or his/ her spouse has calculated saving needs for retirement and their savings goal are equal to or below (above) 300 thousand yuan, otherwise zero. We add the natural logarithm of net wealth (excluding the value of all financial products including stocks, mutual funds, government bonds, financial derivatives, and other financial products) from the 2014 wave in columns 15 to 17 (in columns 9 to 14). Other controls include Age, Female, Marriage, Middle school, High school, College, Work, Health, Types of social or occupational pension coverage, Urban *hukou*, Traditional view, Family size, Relative support, Ln (Income), Financial difficulty, Severity, Patience, Risk aversion, and Present bias. Variables are defined in Table 1. Ln (X) is the natural logarithm transformation of X. Heteroskedasticity-robust standard errors are given in parentheses. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

## Appendix B: Cognition module in CFPS

CFPS has developed four distinct cognition tests, namely, vocabulary, numeracy, quantitative reasoning, and memory. To streamline the interview process, these four tests are grouped into two pairs and alternate across different survey waves. In the 2010, 2014, and 2018 waves, the CFPS tests respondents' cognitive abilities with vocabulary and numeracy questions, while in the 2012, 2016, and 2020 waves, memory and quantitative reasoning questions are used. Each type of cognitive test encompasses multiple sets of questions. The system dynamically selects which set of questions to present in the current wave based on the respondent's prior testing experience. For individuals who have previously taken a particular test, the system will automatically load the next set of questions in sequence from the last test taken. For those new to a specific test, the system will choose a set of questions randomly. Furthermore, within the same survey administered to a family, efforts are made to assign different sets of questions to family members whenever possible. Cognition tests are only administered during offline interviews, so approximately 90% of respondents did not take the tests in the 2020 wave due to the impact of Covid-19.

### *Vocabulary and numeracy tests*

The tests for vocabulary and numeracy are designed to measure individuals' crystallized intelligence. The former one is conducted by the interviewer asking the respondent to read the word on the card shown to them while the latter one includes mathematical questions associated with addition, subtraction, multiplication, division, exponential, logarithm, trigonometric function, sequence, and permutation combination. In total, there are 8 (4) sets of vocabulary (numeracy) test with a *similar* level of difficulty, with 34 (24) questions in each set, arranged in order from easiest to hardest.

These questions are derived from the standard curricula of primary and secondary schools. To make the two tests more efficient, the respondent with the education level being high school and above (middle school, primary school and below) is assigned the 21<sup>st</sup> (9<sup>th</sup>, 1<sup>st</sup>) question of vocabulary test and the 19<sup>th</sup> (13<sup>rd</sup>, 1<sup>st</sup>) question of numeracy test. In the 2010 wave, the tests stop whenever the respondent gives incorrect answers to three consecutive questions. The final score is the serial number of the last question the respondent answers correctly. If the respondent does not answer any question correctly, their final score is the serial number of the question before their starting question (Type I: assuming fixed starting points). In the later waves, an adjustment is made to the design: The respondent's initial starting question is still determined by their education level, but when they answer the initial starting question incorrectly, they need to answer from the starting question belonging to a lower level until they return to answering from the 1<sup>st</sup> question (Type II: not assuming fixed starting points). The CFPS provides test results of Type II in the 2014 and 2018 waves and provides results of Type I in all the 2010, 2014, and 2018 waves (with the results of the latter two waves calculated hypothetically following the rules in the 2010 wave). We only employ Type II cognition tests throughout the paper, as they are less dependent on education level and, consequently, exhibit higher variation in test scores within each education group.

Unfortunately, the CFPS does not disclose the questions of the two tests considering that they will be used again in future waves.

*Quantitative reasoning and memory tests*

Quantitative reasoning test employs a two-stage adaptive test. In the first stage, the respondent answers the three same number series questions (e.g., 8...[]...12...14). In the second stage, there are four sets of number series questions, with 3 questions in each set, with a *different* level of difficulty. The system selects one set of questions based on the number of correct answers in the first stage, with those who answer more questions correctly in the first stage being given more difficult sets in the second stage. This design adheres to modern measurement theory, aiming to more accurately measure an individual’s true ability in as short a period of time as possible. Rather than merely tallying correct answers, the CFPS utilizes a Rasch item response theory (IRT) model to derive the final score of the test, which takes into account the specific questions assigned to each respondent. In the 2012 wave, many respondents have missing values on this test due to them stopping the test before commencing the number series section when they indicate an inability to comprehend two example questions related to number series. In subsequent waves, all respondents are requested to participate.

The tests for memory and quantitative reasoning are designed to measure individuals’ fluid intelligence and adopted from the Health and Retirement Study. The memory test has four sets of questions with a *similar* level of difficulty, with 10 questions in each set. The interviewer reads 10 words that are common in life (e.g., mountain, rice, and river) from one set to the respondent, and the respondent recalls the words read by the interviewer immediately after listening to all 10 words, and those who do not recall a single word on the first attempt are allowed to have a second attempt. The score obtained from this round is defined as the immediate memory score. Several minutes after the immediate memory test, the interviewer asks the respondent to recall the words again, and the score obtained from this round is defined as the delayed memory score.

Table B1 Observation for four tests of cognitive abilities across waves

	Vocabulary (Type I)	Numeracy (Type I)	Vocabulary (Type II)	Numeracy (Type II)	Quantitative reasoning	Memory
2010	1,814	1,814	/	/	/	/
2012	/	/	/	/	1,237	1,796
2014	2,231	2,231	2,231	2,231	/	/
2016	/	/	/	/	1,427	1,376
2018	1,208	1,209	1,208	1,209	/	/
2020	/	/	/	/	73	71

This table presents the observations for four tests of cognitive abilities across waves in the non-retired sample. / means the test is not conducted in that wave. The results of Type I vocabulary and numeracy tests in the 2014 and 2018 waves are calculated hypothetically following the rules in the 2010 wave.