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Building Up, Spending Down

Financial Literacy, Retirement Savings Management, and Decumulation

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WR-712

September 2009

This paper series made possible by the NIA funded RAND Center for the Study of Aging (P30AG012815) and the NICHD funded RAND Population Research Center (R24HD050906).

LABOR AND POPULATION

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29 September 2009

[1] This research has been supported by funds from the Department of Labor and the National Institute on Aging via the RAND Roybal Center for Financial Decision Making. We thank Jeff Dominitz, Arie Kapteyn, and Annamaria Lusardi for assistance in the design of the survey and helpful comments. The findings and conclusions expressed are solely those of the authors and do not represent the views of DOL, NIA, any agency of the Federal Government, or the RAND Corporation. The authors are responsible for all errors and omissions.

1. Introduction

Over the past few decades, risks associated with providing for financial security in retirement have increasingly shifted from employers to employees as employer-provided pensions have shifted from defined-benefit to defined-contribution (DC) plans in the United States. DC plans require employees not only to bear investment risk but also to make financial decisions for which they may be poorly prepared. The growth of individual retirement accounts (IRAs) outside of employer-sponsored plans raises similar concerns.

Recent work in behavioral finance suggests that investors do not make optimal investment decisions in their DC plans. Mottola and Utkus (2009) examine data from nearly 2.9 million 401(k) participants in a sample of Vanguard investors and find that only about 45 percent of investors are constructing portfolios with equity allocations that may be consistent with expert advice. Furthermore, people who are less financially literate may be more likely to unknowingly commit financial mistakes, including those related to retirement planning (Lusardi and Mitchell, 2007a, b).

Various segments of the U.S. population have been found to lack various types of financial skills (Hilgert, Hogarth and Beverly, 2003; Lusardi and Mitchell, 2007a, b).[2] Analyzing survey responses from the 2004 Health and Retirement Study, Lusardi and Mitchell (2006, 2007b) find that only half of adults close to retirement age and older correctly answered two simple questions regarding interest compounding and inflation, and only one-third correctly answered these two questions and a question about risk diversification. Furthermore, large discrepancies in measured financial literacy exist, potentially placing some economically vulnerable groups (the poor, the less-educated and minority households) at further disadvantage. These measures have been linked to suboptimal behavior – Hilgert, Hogarth and Beverley (2003) find that individuals with more financial knowledge are more likely to engage in a wide range of recommended financial practices, while Lusardi and Mitchell (2006, 2007a) find that among older adults, those who displayed better financial knowledge were more likely to plan, to succeed in planning, and to invest in complex assets.

A great deal of variation continues to exist in how researchers define and measure financial literacy itself. The Presidents Advisory Council on Financial Literacy (PACFL, 2008), convened to "improve financial literacy among all Americans," defines financial literacy as "the ability to use knowledge and skills to manage financial resources effectively for a lifetime of financial well-being."[3] However, it is unclear how widely the PACFL definition is accepted. Throughout the literature, financial literacy has been variably defined as (a) a specific form of *knowledge*, (b) the *ability* or skills to apply that knowledge, (c) *perceived knowledge*, (d) good financial *behavior*, and even (e) financial *experiences*. For more discussion on the various conceptualizations and operationalizations of financial literacy, please see Hung, Parker, and Yoong (2009).

[2] Findings of widespread illiteracy are also reported in studies on smaller samples or specific groups of the population (Agnew and Szykman, 2005; Bernheim 1995, 1998; Mandell,2004; Moore, 2003).

[3] This definition is based on the definition of financial literacy from the Jump$tart Coalition: http://www.jumpstart.org/guide.html.

In this paper we analyze the relationship between financial literacy and retirement account choices, such as contribution, allocation, early withdrawals, and decumulation decisions. In addition to the uncertainty concerning the definition of financial literacy, very little is known about the impact of financial literacy on actual decisions to save for and spend down during retirement. Work by Lusardi and Mitchell (2006, 2007a, 2007b, 2008) focus on the effect of financial literacy on planning for retirement, but since Bernheim, Garrett, and Maki (2001) there has been little evidence on how financial literacy affects actual behaviors.

We report on results from a survey designed to measure multiple dimensions of financial literacy. Using RAND's American Life Panel, a national household panel survey, we conducted a survey module that includes the financial literacy measurement items designed by Lusardi and Mitchell (2006) as well as items intended to measure literacy related to investing, life insurance, and retirement accounts. The survey instrument also measures respondents' self-reported financial knowledge and skills.

We developed structural unidimensional and multidimensional measurement models of objective and self-assessed financial literacy that incorporate the many indicators in the ALP database, taking the distributional characteristics of the variables (unordered and ordered categorical) into account. The multidimensional model of objective financial literacy specifies three "subdomains" for financial literacy: basic financial literacy, literacy in investment-related knowledge, and literacy in life insurance and annuities knowledge. The unidimensional model of objective financial literacy is more restrictive; it specifies only a single dimension of financial literacy. Similarly, the multidimensional model of self-assessed financial literacy allows for two "subdomains": self-assessment of financial knowledge in general, and self-assessment of personal financial details, whereas the unidimensional model of self-assessed literacy specifies only a single dimension.

The models applied here are well-established in psychometric item response theory (IRT). However, unlike most applications of IRT, our estimates take sampling weights into account and thus are population representative. Furthermore, they allow for missing data that arises from survey non-response, item non-response, and ALP survey design. This modeling approach has been applied to the measurement of health in previous research (Meijer, Kapteyn, and Andreyeva, 2008). The estimated models allow us to compute financial literacy indices, which are the optimal estimates of the underlying unobserved true values of the financial literacy concepts in the models.

These indices measure financial literacy well, with reliabilities ranging from a satisfactory 0.73 to an excellent 0.94. When comparing unidimensional models against multidimensional models, we find that unidimensionality is strongly rejected statistically. However, the pseudo-R^2 values of the multidimensional models are only marginally higher than the pseudo-R^2 values of the unidimensional models and the subdomain indices are highly correlated. Together, these indicate that multidimensional models may have little added value and one knowledge index and one self-assessment index suffice. Moreover, when we examine the relationships between the financial literacy indices and financial behavior, we find that the subdomain indices do not offer any additional predictive insights than the one-dimensional indices.

We analyze the relationship between measures of financial literacy and retirement account choices. As in previous work by Lusardi and Mitchell (2006, 2007a, 2007b, 2008) and Bernheim et al. (2001), we find that our various measures of financial literacy predict how much a respondent has thought about retirement. Likewise, we find that our financial literacy measures, especially the self-assessed measures, predict planning for spending down money in retirement. However, even though we find that financial literacy predicts retirement planning, we find that our financial literacy measures do not strongly predict specific behaviors associated with accumulating retirement savings, such as contributions to DC plans. We also find that our financial literacy measures do not strongly predict whether respondents are more likely to make common investment mistakes with their retirement portfolios, such as holding portfolios with zero equity, or are too aggressive, or too conservative.

We also examined how financial literacy varies across the population and we find that financial literacy is monotonically related to age, with older individuals having higher levels of financial literacy. The statistics show that economically disadvantaged individuals tend to have lower levels of financial literacy: minorities (Hispanic, African American), women, not married individuals, lower educated (high school or less), not employed (but also not retired), and lower income (household income less than $50,000 per year). The means of these (not mutually exclusive) subpopulations are 0.2-0.5 standard deviations below the population mean. This is a sizable difference, but it also indicates that there is large variation within these subpopulations.

2. Measuring Financial Literacy

We designed a new measure of financial literacy that allows for two separate, but complementary types of questions: questions that measure a respondent's financial knowledge and questions that ask the respondent to report on his assessment of his own financial decision-making abilities. The full text of the items from the survey instrument is reproduced in Appendix A.

Researchers have used both performance tests and self-report methods to measure financial literacy. Performance tests are primarily knowledge-based, whereas self-reports assess perceived knowledge or confidence in knowledge (i.e., how much you think you know). However, individuals often think that they know more than they actually do (OECD, 2005). And although actual and perceived knowledge are often correlated, this correlation is often moderate at best. For example, Agnew and Szykman (2005) found correlations between actual and perceived financial knowledge that ranged from .10 to .78, across demographic groups (the median correlation was .49 across 20 categories).

Nevertheless, emerging evidence suggests that perceived knowledge, or confidence, may have predictive ability of its own, above and beyond actual knowledge. This phenomenon may derive from the fact that individuals do not usually know the extent of their actual knowledge. They must instead decide on courses of action (e.g., to collect more information, to make an educated guess) based on how much they think they know (Lusardi & Mitchell, 2007b). Given the modest correlation between knowledge and confidence, the latter is able to add predictive validity. For example, Parker, Yoong, Bruine de Bruin, and Willis (2008) found that

confidence in knowledge predicts self-reported retirement planning and savings, as well as performance on a hypothetical investment task, independently of the effect of actual knowledge.[4, 5] Therefore, we believe that both actual knowledge and perceived knowledge have an impact on financial behavior.

Financial Knowledge

The financial knowledge questions in our measure include the 13-item scale from Lusardi and Mitchell (2006). Five items cover basic financial concepts such as numeracy, compound interest, and inflation, and eight items focus on investing and topics such as the stock market, stocks, bonds, mutual funds, and diversification.

In addition to these questions, our measure includes further questions about investing, life insurance and annuities, and dedicated retirement accounts. The six additional investing questions ask respondents about the definitions of stock, bond, and mutual fund. Furthermore, respondents are asked about fees and risks associated with mutual funds. The four questions on life insurance and annuity items ask respondents about the difference between whole and term life insurance, the definition of the cash value of a life insurance policy, and the definition of an annuity. The five questions on dedicated retirement accounts focus on the rules related to contributions to and withdrawals from IRAs and 401(k) plans. In particular, these questions ask about the tax implications of dedicated retirement plans, eligibility for IRAs, contribution limits, and tax consequences for early withdrawals.[6]

Self-assessment of financial skills and knowledge

We asked respondents to assess their own financial abilities. First, we asked respondents to rate their financial abilities and knowledge, in general. Respondents were presented with the following statements and asked to rate, on a 6 point scale, the degree to which they agree that the statement describes themselves:

1. I am pretty good at math.

2. I understand the stock market reasonably well.

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[4] Lusardi and Mitchell (2007a, 2007b, 2008) also showed that actual financial knowledge influences planning behavior.

[5] Lusardi and Mitchell (2007b) and van Rooij et al. (2007) report strong correlations (based on tabular data, rather than a correlation coefficient) between perceived and actual financial literacy, taking this as validation of the actual financial literacy factor score (a questionable assumption). Lusardi and Mitchell (2007b) then show parallel regressions predicting retirement planning with actual and perceived financial literacy. No attempt is made, however, to show marginal predictive power when considering both of these two measures simultaneously (i.e., in the same equation). van Rooij et al. (2007) do provide regressions including both perceived financial literacy and actual financial literacy (but only the basic financial literacy index, leaving out actual sophisticated financial literacy), with both measures predicting stock-market participation.

[6] The measure had originally included an item on minimum distribution requirements, However, the Worker, Retiree, and Employer Recovery Act of 2008, as signed into law in December of 2008 and waived minimum distribution requirements for 2009. Because the survey was fielded so soon after the signing of the Act (from March, 2009 to September, 2009) and because the Act waived the requirements for 2009, but not 2008, we dropped the item from the measure.

3. I like to think about or follow the stock market.

4. I understand how to invest reasonably well.

5. I am familiar with the different types of investments available to me.

Respondents were also asked to assess their understanding of economics on a 7-point scale:

6. How would you assess your understanding of economics?

After asking respondents to assess their own financial knowledge, generally, we also asked them to assess their understanding of their specific financial situation. We asked respondents who hold mutual funds to assess their knowledge of the fees associated with their mutual funds. They were presented with the following statements and asked to rate, on a 6 point scale, the degree to which they agree that the statement describes themselves:

1. I have a good understanding of the fee structure of my mutual funds investments

2. When I first invested in my mutual funds, I had a good understanding of the fee structure

These respondents were also asked to give an estimate of the typical expense ratio of the mutual funds in their portfolios. We also asked respondents to give an estimate of the typical load (if any) for mutual funds in their portfolios. We followed up each of these questions by asking how certain they felt about their fee estimates:

How certain are you of your previous answer?
(1) Very certain; (2) Certain; (3) Not certain or uncertain; (4) Uncertain; (5) Very uncertain

Respondents who reported being eligible for an employer-sponsored DC plan were asked to assess their knowledge of the features of the plan, on a 7-point scale:

How knowledgeable are you about the retirement plan offered by your employer?

Lastly, respondents who are enrolled in a DC plan were presented with the following items:
Please think back to when you first enrolled in your retirement plan. When you were making your initial enrolment decisions, how knowledgeable were you about the features of the plan?

Please think back to when you first enrolled in your retirement plan. When you were making your initial retirement plan investment decisions, how knowledgeable were you about the fees and expenses associated with the plan?

3. Data Description and Summary Statistics

The financial literacy survey

The financial literacy survey, MS64, was administered to members of the RAND American Life Panel (ALP), an Internet panel of respondents 18 and over. Respondents in the panel either use their own computer to log on to the Internet or a Web TV, which allows them to access the Internet using their television and a telephone line. The technology allows

respondents who did not have previous Internet access to participate in the panel. ALP members are recruited from among individuals age 18 and older who respond to the monthly Survey of Consumers conducted by the University of Michigan's Survey Research Center. The monthly survey produces, among other measures, the widely used Index of Consumer Sentiment and Index of Consumer Expectations.

Retirement behavior

In order to analyze the relationship between financial literacy and actual investment behavior, we also use data from Wave 73 of the ALP. Wave 73 was given to 2224 respondents who answered detailed questions about their investment behavior related to retirement accounts. Of these 2224 respondents, 618 report that they are currently enrolled in a defined-contribution pension plan. These respondents were asked about retirement account contributions, whether they take advantage of employer matching in retirement accounts, portfolio allocation, pre-retirement withdrawals or distributions, advice-seeking and decumulation.

Sample Summary Statistics

Upon joining, respondents to the ALP complete a separate survey about individual demographic, work history and other household information, and they are prompted to update their background information each time they log in to a new module. This provides a series of self-reported demographic characteristics of interest, including birthdate, gender, education, ethnicity, occupation, state of residence and income. Members of the ALP tend to have more education and income than the broader U. S. population. Of the 469 respondents who participated in Wave 64 and report that they are currently enrolled in a defined contribution plan in Wave 73 of the ALP, 89% of respondents hold a college degree and 83% have household income greater than $50,000. There are two main reasons for this sample selection. First, the Michigan respondents tend to have more education than the population at large, as described by Census data. Second, the great majority of ALP members have their own Internet access. Americans with Internet access tend to have more education and income than the broader population. As such, for purposes of our analysis, we apply post-stratification sample weights. Table 1 shows the unweighted and weighted summary statistics for full sample of respondents in the ALP and the analysis sample. For the rest of the analysis, we apply population weights to all survey responses.

4. Financial Literacy Measures

In this section, we describe several measurement models that we have estimated for the financial literacy questions, both the financial knowledge questions and the self-assessment questions. The models are derived from well-established psychometric theory: item response theory (IRT). IRT models the probabilities of answers to test items as a function of the underlying trait that they are intended to measure, and derives optimal estimates of the trait from these.[7] See, for example, Bock and Moustaki (2007) for a recent overview of this field.

[7] An additional important topic in IRT is how to combine items into an "optimal" test, which in the current computer age has led to computerized adaptive testing, that is, select items in real time conditional on the current best estimate of the trait based on the answers to previous items. Our questionnaire consists of a fixed set of questions about which little prior information was available, so this topic is not relevant to the current study.

After estimating these models, we compute derived indices of financial literacy accordingly. The models described below were implemented in an adapted version of the program that Meijer, Kapteyn, and Andreyeva (2008) developed for estimating health measurement models and constructing derived health indices.

4.1 A one-dimensional measurement model of general financial literacy

Let *i* denote the question and *j* denote the answer category of the question. For this purpose, we have recoded the original answer categories into "Correct", "Incorrect", and "Don't know". Furthermore, let FL denote the true but unobserved financial literacy. Then the conditional probability that answer category *j* is given to question *i*, P_{ij}, conditional on the value of FL, is assumed to be given by a multinomial logit (MNL) equation:

$$P_{ij}(\mathrm{FL}) = \frac{\exp(\beta_{ij}\mathrm{FL} + \alpha_{ij})}{\sum_k \exp(\beta_{ik}\mathrm{FL} + \alpha_{ik})} \qquad (1)$$

In the context of educational and psychological testing with multiple choice test items, this model was proposed by Bock (1972). McFadden (1974) showed that, when viewed as a model of discrete choice (and allowing more general dependence on covariates), this model is consistent with utility maximization theory.

A characteristic of this model is that, if FL is very large, then the probability of selecting the answer category with the highest value of β_{ij} approaches 1. Hence, for a question to be a useful measure of the trait we are interested in (financial literacy), the correct answering category must have the highest value of β_{ij}. Analogously, if FL is very small (i.e., large negative), then the probability of selecting the answer category with the lowest value of β_{ij} approaches 1 and the probabilities of the other categories, in particular the correct answering category, approach 0. In ordinary testing circumstances, this is an unrealistic characteristic, because in such a case, random guessing would lead to positive probabilities of all answering categories including the correct one. Therefore, Samejima (1979) and Thissen and Steinberg (1984) extended the model with a hypothetical "don't know" category, which would be the one with the lowest value of β_{ij}, and assumed that individuals who would "choose" this category would in fact randomly guess one of the other categories. In our data, we have an explicit "don't know" category, and unlike most educational and psychological testing situations, strong incentives for random guessing are absent. Moreover, exploratory analyses showed little evidence of random guessing. Hence, we use the model (1) without such modifications for random guessing.

For identification, one arbitrary normalization needs to be imposed on the β's and one on the α's. It is most convenient to normalize the coefficients for the "Don't know" category to zero, so that the logic discussed above implies that the estimated β's for the "Correct" and "Incorrect" categories should be positive, and the β for "Correct" should be higher than the one for "Incorrect".

In contrast to typical applications in economics, in which multinomial logit models can be estimated straightforwardly, the model (1) is not immediately operational, because FL is not observed. To allow estimation, it is commonly assumed that the unobserved trait (FL) is standard normally distributed. Then the unconditional probability of each category is obtained by integrating (1) over this standard normal distribution. Let j_{ni} be the answer category chosen by respondent *n* for question *i*. Then the unconditional probability of observing respondent *i*'s complete answering pattern is

$$L_n = \int_{-\infty}^{\infty} \left[\prod_i P_{i,j_{ni}}(z) \right] \phi(z) \mathrm{d}z = \int_{-\infty}^{\infty} \left[\prod_i \frac{\exp(\beta_{i,j_{ni}} z + \alpha_{i,j_{ni}})}{\sum_k \exp(\beta_{ik} z + \alpha_{ik})} \right] \phi(z) \mathrm{d}z \,,$$

where $\phi(\bullet)$ is the standard normal density function. Estimators are obtained by maximizing the log-pseudolikelihood

$$\ell = \sum_n w_n \log L_n$$

where w_n is the sampling weight. We compute the integral by Monte Carlo integration with 100 Halton draws and corresponding 100 antithetic draws. The resulting estimators are thus maximum simulated pseudo-likelihood estimators. See Train (2003) for an extensive treatment of maximum simulated likelihood estimation.

Exploratory analysis showed that some of the dedicated retirement accounts questions had undesirable characteristics. In particular, for several of them, the correct answer is "it depends" and for these questions, the probability of giving the correct answer decreases as financial literacy increases, and the probability of answering incorrectly increases. Questions for which a simple "yes" or "no" was the correct answer did not show this anomalous characteristic. We speculate that this indicates that individuals with high financial literacy may have investigated these issues (e.g., whether they are allowed to invest in both a 401(k) and an IRA) and perhaps acted on this (e.g., they actually invested in both a 401(k) and an IRA, or found out they were not allowed to), and they gave the answer that is relevant for their particular situation and not hypothetical other 401(k) plans in which they are not enrolled. Because of this erratic characteristic of these questions, we have omitted these questions. Hence, our models include just the 23 questions on basic financial concepts, investing, life insurance, and annuities.

Table 2 shows the fit statistics of this model in the middle column, and compares it with the *null model*, which assumes that the answers to all questions are stochastically independent. This model here is analogous to the constant-only regression model. As expected, the one-dimensional model is a clear improvement over the null model. The scaled likelihood ratio (LR) test statistic (Asparouhov and Muthén, 2005) is highly significant: Stata is not able to distinguish the *p*-value from 0. High significance is not unusual in this type of model, as the null model is very unlikely to fit well. The pseudo-R^2 is 0.47. We do not have much experience yet with pseudo-R^2s in this type of model, so it is difficult to say with confidence whether this is high or low. But in multinomial logit regression models, a good pseudo-R^2 is often in the range of 0.3-0.4 (e.g., Rouwendal and Meijer, 2001), and in our health measurement model

(Meijer, Kapteyn, and Andreyeva, 2008), the pseudo-R^2s were in the range of 0.25-0.30, so it appears that the fit of the current model is very good.

The first four columns of Table 3 show the estimation results. Consistent with the logic of the model, for each question, the β for the "Correct" category is the highest, and the β for "Don't know" is the lowest (i.e., the one for "Incorrect" is positive but smaller than the one for "Correct"). Larger β coefficients (esp. for "Correct") imply a stronger relationship between the underlying dimension and the observed indicator. From the table, we see that the investment (IN) questions are generally most strongly related to the underlying dimension. The α's relate to where in the distribution of the underlying dimension the sensitivity is the highest, i.e., where do category probabilities change most rapidly as a function of the underlying dimension, although the precise relation is a bit complicated and depends on the β's as well. Therefore, we have plotted these 23×3 curves (available on request). From these, we conclude that sensitivity is generally highest left of the center of the distribution (or occasionally near the center). In other words, low financial literacy is more accurately measured than high financial literacy.

4.2 A three-dimensional model with separate subdomains

The financial literacy questions consist of three sets of questions, each representing a subdomain. The first is basic financial literacy (BF), consisting of 5 questions on basic financial concepts, the second is investment (IN), consisting of 14 questions on features of financial products, risk and return, and the stock market, and the third is risk management (RM), consisting of 4 questions on life insurance and annuities. It is then natural to assume that each of these sets measures a (slightly) different subdomain of financial literacy. Hence, we may postulate a model with three underlying dimensions instead of only one as in the previous section. For each question, the probability of a certain answering category is then still given by an expression of the form (1), but instead of FL, the underlying dimension is BF, IN, or RM, depending on which set a question belongs to. Each of these three underlying dimensions is assumed to be standard normally distributed, and they are also jointly multivariate normally distributed. We allow the correlations to be nonzero. (The previous model is obtained as a special case by setting all correlations between these dimensions to 1, so that they are effectively the same dimension.)

The fit statistics of this model are presented in the last column of Table 2. The Scaled LR test statistic for testing this model against the one-dimensional model is highly significant, and the information criteria (AIC and BIC) also favor this model over the one-dimensional model. However, the increase in the pseudo-R^2 is very small (0.472 vs. 0.467), so in terms of explanatory power this model provides only a marginal improvement.

For interpreting the estimation results, it is most insightful by starting with the estimated correlations between the underlying dimensions. These are presented in Table 4. We see that the IN and BF dimensions are very strongly correlated, and the RM dimension is somewhat less strongly correlated with the other two dimensions, but the correlations are still quite high. (In our experience, typical correlations are between 0.3 and 0.5, with lower correlations more

common than higher.) However, it is also clear from looking at the standard errors that indeed the correlations differ significantly from 1.

The MNL parameters of this model are presented in the last four columns of Table 3. Again, the results are consistent with the logic of the model: the β's for "Correct" are the highest, and the ones for "Incorrect" are positive. When comparing with the estimates from the one-dimensional model, we see that most parameter values are very similar, especially the ones for the investment subdomain, which was dominant in the one-dimensional model. The β's for the life insurance and annuities subdomain are higher in this model than in the one-dimensional model, which means that these questions measure their specific subdomain better than general financial literacy. A similar story can be told for the basic financial literacy subdomain, although it is even stronger for the first two questions, which is surprising given the high correlation between the BF and IN dimensions.

4.3 Measurement models for self-assessments

As described in section 2, the questionnaire contains a large number of questions that require the respondents to assess their own abilities and knowledge. In this section, we estimate a similar measurement model for these questions as for the objective financial literacy measurements.

These questions all use ordinal scales and therefore, the measurement model we estimate for these questions uses the ordinal probit model structure instead of the multinomial logit model structure. The ordinal probit model is the most common model for ordinal dependent variables. In this model, the probability of answering category *j* to question *i*, conditional on the underlying true self-assessed financial literacy (SAFL) is specified as

$$P_{ij}(\text{SAFL}) = \Phi(\alpha_{ij} - \beta_i \text{SAFL}) - \Phi(\alpha_{i,j-1} - \beta_i \text{SAFL}),$$

where $\Phi(\bullet)$ is the standard normal cumulative distribution function. The α_{ij} are threshold parameters, which are increasing with *j*, with α_{i0} defined to be negative infinity, and the largest α_{ij} defined to be positive infinity. The β_i are factor loadings and are assumed to be the same for all categories of the same variable (otherwise, probabilities are not necessarily between 0 and 1). A positive value of β_i means that higher values of SAFL are associated with higher values of the observed variable. See, for example, Wansbeek and Meijer (2000, section 11.4) or Meijer, Kapteyn, and Andreyeva (2008) for detailed discussions of this model.

Several of the self-assessment questions have missing values for a sizable subset of respondents due to skip patterns. In particular, some questions are only asked if respondents indicate that they invest in stocks or mutual funds, or only if they are eligible for, or enrolled in, DC plans. Our model (and estimation program) deals with missing data by employing the *missing at random* (MAR; Rubin, 1976) or *selection on observables* (Fitzgerald et al., 1998) assumption. This assumption is satisfied if we include the variables that are used in the skip pattern in the model as well. For this reason, we have included two questions about investing in

stocks as covariates in the model. That is, we assume that self-assessed financial literacy is correlated with these variables and thus we specify a predictive regression equation in which self-assessed financial literacy is taken to be the dependent variable and the covariates are the explanatory variables. This predictive equation does not necessarily have a causal interpretation, but merely serves to allow for dependencies between self-assessed financial literacy and the variables determining the skip pattern. See Meijer, Kapteyn, and Andreyeva (2008) for a discussion about the precise (weak) assumptions that correspond with this predictive equation.

The likelihood as given above incorporates a conditional independence assumption: conditional on the value of the unobserved variable, the dependent variables are assumed stochastically independent. Under this assumption, the relationships between the dependent variables are only due to their joint dependence on the unobserved variable that we intend to measure. Modeling the complete route through the FT section about knowledge about the employer pension plans and the FE section on knowledge about plan fees would lead to complications, because this conditional independence assumption would be violated, as the skip patterns for some questions directly depend on the answers to previous questions that are dependent variables in their own right. Therefore, we have used only three questions from these sections, which are not subject to this problem, as dependent variables, and we have included a few binary variables representing the skip patterns as covariates. The resulting set of covariates is:

- *InvestStockMF*: dummy whether respondent indicates investment in stocks or mutual funds (1 if OB2 = 1, 0 otherwise)
- *InvestStockNow*: dummy whether respondent indicates investment in stocks or mutual funds outside retirement accounts (1 if OB5 = 1, 0 otherwise)
- *EmpbyOther*: dummy whether respondent has been employed but not self-employed in the past 2 years (1 if OB9 = 1 or OB9a = 1, 0 otherwise)
- *mf_load*: dummy whether respondent's mutual fund charges load fees
- *DCElig*: dummy whether respondent is eligible for an employer-provided DC plan
- *DCEnroll*: dummy whether respondent is enrolled in an employer-provided DC plan

We normalize the factor loading of *KnowEcon* ("How would you assess your understanding of economics?") to 1 and normalize the first threshold of this indicator to 0. No other normalizations are necessary and in particular, we can estimate the intercept and the variance of the residual of the predictive regression equation as free parameters.

The fit statistics of this model are given in the second column of Table 5. As usual, the model fits much better than the null model and the difference is statistically highly significant. However, the pseudo-R^2 of this model is much lower than for the models for the objective measurements. This reflects greater idiosyncratic components in these questions than in the objective questions. For example, whether respondents believe they are good at math and whether they think they know the stock market well are relatively weakly related to each other.

Table 6 presents the estimation results of this model. The factor loadings have the expected signs and the threshold parameters are well-spaced. The questions on knowledge of and

interest in the stock market and understanding of investments are most strongly related with the common underlying dimension, whereas whether one is good at math is only weakly related to the underlying dimension. The predictive equation shows that, as expected, actual investment in stocks or mutual funds is strongly positively related to self-assessed financial literacy. Eligibility for, and enrollment in, an employer-provided DC plan appears to be unrelated to self-assessed financial literacy.

As an extension to this one-dimensional model, we have estimated a multidimensional model as well, analogous to the multidimensional model for the knowledge questions. For the self-assessments, we can observe that some of the questions pertain to general (self-assessed) knowledge and ability, whereas other pertain to the specific investments and DC plans of the respondents. Therefore, we have estimated a two-dimensional model, with the assumed dimensions (self-assessed) basic skills literacy ("Basic") and (self-assessed) contextual literacy ("Cont"). The fit statistics in the last column of Table 5 show that again, the statistical improvement is highly significant, but the improvement in the pseudo-R^2 is modest. Estimation results of the two-dimensional model are presented in Table 7. It is striking how similar the results are to the results for the one-dimensional model. Again, this suggests that the added value of the second dimension may not be high, despite the statistical significance. However, we explore the value of these dimensions in predicting financial behaviors in Section 5 below.

4.4 Indices of financial literacy and self-assessed financial literacy

After the parameters of the models have been estimated, we can estimate the values of the underlying dimensions, which results in indices of financial literacy, its subdomains, and self-assessed financial literacy and its subdomains. These indices are computed as the conditional means of the true underlying dimensions, conditional on the observed variables in the model. For example, in the one-dimensional model for the knowledge questions, with unobserved financial literacy (FL) as underlying dimension, the index of financial literacy is defined as $\mathrm{MFL} = \mathrm{E}(\mathrm{FL} \mid y)$, where y is the vector of observed indicators (the BF, IN, and RM questions). The conditional mean is the optimal estimator in the sense of minimizing mean squared error. We can also estimate this mean squared error and compute the *reliability* of the resulting measure, which is the squared correlation (= R^2) between the index and the unobserved true value. See Meijer, Kapteyn, and Andreyeva (2008) for technical details.

Table 8 shows some distributional characteristics of the indices. Most important are the estimated reliabilities. All of these are satisfactory (Nunnally, 1978, gives 0.70 as a rule of thumb for a satisfactory reliability) and especially self-assessed financial literacy is very well measured. Additionally, the high correlations among the indices are noteworthy. For example, self-assessed basic skills literacy ("Basic") from the two-dimensional model appears almost identical to self-assessed financial literacy from the one-dimensional model (SAFL), but also the self-assessed basic skills and contextual measures correlate very highly, as do the MFL, IN, and BF indices. This is no surprise given the estimation results discussed above, but as stated there, it may imply that there is not much added value in using multiple indices, rather than a single index, in modeling economic behavior. This will be assessed in Section 5.

4.5 Financial literacy and demographic characteristics

Table 9 shows the means of the various indices for socio-demographic subpopulations of interest. In many respects, this table shows that economically less advantaged individuals have lower financial literacy on average. This holds for gender (females have lower values), race/ethnicity (hispanics and blacks have lower values), marital status (unmarried individuals have lower values), education (lower educated have lower values), and income (individuals from households with lower household income have lower values). It also holds for labor force participation, where retirees have the highest values of the indices and non-retired not employed individuals (i.e., unemployed, disabled, and homemakers) have the lowest values. However, the estimate for the self-assessed contextual literacy index of the non-employed is higher than that for the employed, but this difference is small and nonsignificant, because of the large standard error of this value for the non-employed. The relationship with age is generally monotonic, with older age groups having higher mean values of the indices, but again there is a minor nonsignificant exception for the self-assessed contextual literacy index.

For most demographic variables, the difference in highest and lowest subpopulation mean value of the indices is about half a standard deviation. This is sizable, but it also indicates that there is still considerable overlap in the distributions of the indices.

5. Retirement savings management and decumulation

In Wave 73 of the ALP, we asked respondents about an array of retirement plan-related behaviors, including current contributions, portfolio allocation, and decumulation. We begin by asking respondents to rate how much they have thought about retirement, on a 4-point scale of: *(i) Hardly at all, (ii) A little, (iii) Some, and (iv) A lot*. Next, respondents self-report estimates of the total dollar amount in their 401(k) plans at the end of 2008 and the percentage of total retirement savings held in their 401(k) plans. We can then calculate the total value of their retirement savings at the end of 2008. In our sample, 5% or respondents report that they have hardly thought about retirement, 24% have thought a little, 37% have thought some, and 34% have thought a lot about retirement. Median and average amounts of 401(k) plans are $15,000 and 55,943, respectively, and median and average total retirement savings are $56,700 and $177,945.

We then ask respondents to report specific behaviors associated with accumulating savings in their 401(k) plans, including whether or not they made contributions in 2007 and 2008, and the percent of salary withheld in 2008. Respondents were also asked to report their total dollar contribution in 2008 by category: (1) $ 0 – 4999, (2) $ 5000 – 9999, (3) $ 10000 – 14999, (4) $ 15000 – 19999, (5) > $ 25000.[8] Individuals who report that their employer offers to match 401(k) contributions are asked whether they received the maximum possible match. Lastly, we ask respondents whether they make the maximum allowable contribution to their retirement plan. We find that 82% and 89% of respondents made contributions in 2007 and 2008, respectively, and that 81% of respondents made contributions in both years. The median and

[8] Note that, due to a programming error, the dollar amounts $20,000-$25,000 are not represented by any of the categories. None of the respondents noted this error in the comments section at the end of the survey

average percent withheld for 401(k) contributions are 6.00% and 7.35%. For our sample, 60% contributed $ 0 – 4999, 19% contributed $ 5000 – 9999, 10% contributed $ 10000 – 14999, 5% contributed $ 15000 – 19999, and 2% contributed over $25000. Finally, 63% of respondents receive the maximum possible employer match and 26% of respondents make the maximum allowable contribution.

Individuals are also asked to report on the asset allocation of their plan balance in 2008. Using their self-reports, we construct indicators of common "mistakes", based on common investment guidelines used in Mottola and Utkus (2009). The "mistakes" that we look at are (i) holding zero equity, (ii) holding an underdiversified portfolio (i.e., holding only one asset class), (iii) being overly aggressive (holding more than 95% in equity), and (iv) being too conservative (holding less than 40% in equity). We find that 7% of respondents hold zero equity, 18% hold underdiversified portfolios, 14% are overly aggressive, and 28% are too conservative. We also include two measures of interaction with their portfolio: the frequency of checking balances and the frequency of changing. Both these questions were asked on a 4-point scale: *(1) Monthly or more frequently, (2) Quarterly, (3) Yearly, and (4) Almost never*. We find that 19% check portfolio balances monthly or more frequently, 44% check quarterly, 6% check yearly and 12% almost never check their portfolio balance. Furthermore, 1% adjust their portfolios monthly or more frequently, 11% adjust quarterly, 21% adjust yearly and 48% almost never adjust their portfolios.

We asked respondents whether the current economic recession has affected their retirement plans. In particular, we asked how their 2008 401(k) contributions compared to their 2007 contributions. 17% report that their contributions increased from 2007 to 2008, 7% report that their contributions decreased, and 58% report that their contributions stayed the same. We asked whether respondents reduced or stopped contributions in 2008 and we find that 7% reduced or stopped contributions due to economic hardship, 6% reduced or stopped contributions due to concerns about losses in the financial markets, and 4% reduced or stopped contributions due to concerns about stability and security of financial institutions. If we look at respondents who actually reduced their contributions, these percentages are 33%, 26% and 18%, respectively. Respondents also reported whether they borrowed money from their defined-contribution plans, or made any pre-retirement withdrawals from their plans. 6% of respondents had a pre-retirement disbursement; 4% borrowed money from their plan and 0.2% withdrew money from their plan.

We also ask about planning for decumulation after retirement. Individuals are asked if they have ever tried to figure out their future withdrawals, if they have made a plan to do so, and if they think their plans will meet their needs. Panel A of Table 10 shows that only 28% of respondents have thought about how much they should withdraw from savings every year in retirement. Of these respondents, 43% have developed a plan for spending down savings during retirement, and of those respondents, only one-third believe that their plan will meet their future needs during retirement. When we look at the overall sample (Panel B, Table 10), only 12% have developed a decumulation, and only 4% believe that their plan is sufficient for their needs.

Financial Literacy and Retirement savings management

Past research (see, for example, Lusardi and Mitchell, 2006) have shown financial literacy is significantly related to retirement planning. In this section, we investigate the relationships between our financial literacy indices and some of the retirement savings behaviors described above.

Column (1) of Table 11 displays OLS estimates from regression of the degree to which the respondent has thought about retirement on each of the indices—measured financial literacy, self-assessed financial literacy, as well as the subdomain indices[9]—and demographic controls for gender, ethnicity, income, age, education and marital status. We find that each of the financial literacy indices is significantly related to thinking about retirement. In particular, an increase in any of the financial literacy measures corresponds to more thought into retirement. However, we find that even though each of the financial literacy indices is positively related to the total dollar amount held in 401(k) plans, none of these relationships is statistically significant (Column (2)). Likewise, even though an increase in financial literacy corresponds to higher total retirement savings, only the relationship between self-assessed basic skills literacy and total retirement savings is significant, as seen in Column (3).

We then investigate the relationships between financial literacy and specific behaviors associated with accumulating savings in their 401(k) plans in 2008 (Table 12). Although it is difficult to draw normative conclusions about the relationship between financial literacy and these sort of short-term savings behaviors without more complete knowledge of the individual's whole financial situation at that time, it is surprising that we do not find stronger relationships between financial literacy and these behaviors. We find no relationship between financial literacy and whether respondents contributed to their DC plans in 2008 (Column (1)), but 89% of respondents report that they contributed to their DC plans. Each of the financial literacy indices are positively related to the percent of salary withheld for DC plan contribution, but only the relationship between self-assessed contextual literacy and percent of salary withheld is significant (column 2). As shown in Column 3, each of the financial literacy indices is also positively related to the total dollar contribution to DC plans, and each of these relationships is significant, except for the ones with the risk management literacy subindex and the self-assessed contextual literacy subindex. Columns 4 and 5 show the results for whether the respondent received a full employer match and whether the respondent made the maximum contribution to the DC plan. These are strongly significantly related to the self-assessed indices, but not (or very weakly) significantly related to the knowledge indices.

[9] We note that as per the discussion in Section 4, self-assessed contextual literacy is imputed for individuals who are not asked for information about their plans in the literacy survey (MS64), as a result of having indicated that they do not know or are relatively certain they do not have plans. However, in the behavior survey (MS73), 87 of these individuals report having a plan when asked to give a "yes" or "no" answer. These differences may be due to the wording of the question, to mistakes, or to new plan membership. These individuals are therefore dropped in all regressions where self-assessed contextual literacy is a regressor, resulting in a smaller sample size than other specifications.

Table 13 shows the results from analogous regressions for the investment mistakes and portfolio interaction variables. The results from the regressions for investment mistakes show both positive and negative relationships with the financial literacy indices (Columns 1-4). We would generally expect these relationships to be negative—those who display higher financial literacy would be less likely to make these mistakes—but most of these relationships are nonsignificant. There are some notable exceptions, however. An increase in the Risk Management index is associated with an increase in the likelihood of holding a portfolio with zero equity (Column 1). A possible hypothesis for this relationship is that those who are more knowledgeable about life insurance and annuities tend to be more risk-averse, and therefore, tend not to hold equities. Adding additional support for this hypothesis is that those who score higher on Risk Management Literacy are less likely to hold portfolios that are too aggressive (Column 3). We also see that those who score higher on Measured Financial Literacy are less likely to be too aggressive in their investments. Columns 5 and 6 show the relationships between the frequency of checking and changing one's portfolio and financial literacy. We don't find strong relationships between the measure financial literacy indices and frequency of check and changing one's portfolio allocation, but we do find that those who score higher on the self-assessed indices tend to frequently check portfolio performance and re-allocate. This suggests perhaps that individuals who manage their portfolios actively are self-confident about their financial literacy (or vice versa).

Finally, Table 14 shows the results from the regressions of the decumulation planning variables on the indices. Here, most coefficients are large and highly significant. Column 1 shows that a one unit increase in the indices (which is approximately one standard deviation) is associated with an approximately 18 percentage points higher probability that an individual has tried to figure out how to spend down DC plan assets after retirement. Columns 2 and 3 show that the sizes of the coefficients are much smaller for whether the respondents made a plan and whether the respondents think that the plan meets their needs, but the percentages of individuals who say yes to these questions are considerable smaller as well, so that the coefficients are still relatively large. However, the coefficient of the knowledge indices in the equations for whether respondents made a plan are not statistically significantly different from zero, with the exception of the Risk Management Literacy index. Thus, again the outcomes of interest appear to be more strongly related to the self-assessed indices than to the objective ones.

In addition to these regressions with one index in each equation, we have also estimated regressions with all three knowledge subdomains in the equation (instead of the single overall one), regressions with both self-assessed subdomains in the equation (instead of the single overall one), and regressions with both the overall knowledge index and the overall self-assessed index in the equation. The regressions with the multiple subdomains do not give new insights. In most cases, they corroborate the results of the separate regressions with one index per regression, and in other cases, they lead to anomalous results, in which the coefficients of two highly correlated indices have opposite signs, so that their effects largely cancel out. The regressions with both the objective and the self-assessed index confirm that the self-assessed index is more predictive of the economic outcomes than the objective index. The detailed results of these regressions are omitted here, but are available on request.

We have also rerun all regressions on the subset of individuals who indicated that they were the person in the household responsible for the relevant economic decisions. These results are all similar to the ones presented here. Again, the details are omitted but are available on request.

These analyses describe predictive rather than causal relationships between financial literacy and behavior. In line with Lusardi and Mitchell (2009) and Bernheim, Garrett and Maki (2001), we note that we attempted to identify causality by employing an instrumental variables strategy. Following Lusardi and Mitchell (2009) as well as Bernheim et al (2001), we collected data on each individual's state of residence at age 17. We collected data on high school financial education mandates by year and matched the state mandates to individual's state of residence, to identify whether or not each respondent had been exposed to financial literacy education at the time of high school graduation. While this strategy was successfully exploited by Lusardi and Mitchell (2009), we found the instruments to have no predictive power across all measures of financial literacy. The first-stage regressions do not pass Stock and Yogo's weak instruments criterion (F-statistics < 10), and hence IV estimates are likely to be contaminated by weak instrument bias. In the absence of a econometrically valid IV strategy, we therefore choose to present only OLS regressions where the estimates have a more limited but unbiased interpretation as best linear predictors.

7. Discussion

We find that our financial literacy indices measure financial literacy well, in that the reliabilities of the indices are high. We had designed the survey instrument to measure multiple dimensions of financial literacy, and indeed, when comparing unidimensional models of objective and self-assessed financial literacy against multidimensional models, we find that unidimensionality is strongly rejected statistically. The multidimensional model of objective financial literacy specifies three "subdomains" for financial literacy: basic financial literacy, literacy in investment-related knowledge, and literacy in life insurance and annuities knowledge. Similarly, the multidimensional model of self-assessed financial literacy allows for two "subdomains": self-assessment of financial knowledge in general, and self-assessment of personal financial details. However, we find that multidimensional models have little added value over the unidimensional models, both in explaining underlying financial literacy and in predicting financial behaviors.

We analyze the relationship between measures of financial literacy and retirement account choices. In the research literature, there has been much attention paid to the relationship between financial literacy and retirement planning (such as Lusardi and Mitchell 2006, 2007a, 2007b, 2008; Bernheim et al., 2001). Our respondents have thought a fair amount about retirement—over a third report that they have thought "a lot" about retirement—and we find that financial literacy predicts how much a respondent has thought about retirement. Likewise, we find that our financial literacy measures predict planning for spending down money in retirement, even though our respondents report that they are not well prepared for decumulation in the retirement phase. However, despite the relationship between financial literacy and retirement planning, we find that our financial literacy measures do not strongly

predict retirement preparedness, as measured by size of DC plan accounts or total retirement savings.

Furthermore, we do not find strong relationships between financial literacy and specific behaviors associated with accumulating savings in their 401(k) plans in 2008, such as whether respondents contributed to their DC plan, or the percent of salary withheld for DC plan contribution. However, we find that financial literacy predicts total dollar contribution to DC plans in 2008. Although it is difficult to draw normative conclusions about the relationship between financial literacy and these sort of short-term savings behaviors without more complete knowledge of the individual's whole financial situation at that time, it is surprising that we do not find stronger relationships between financial literacy and these behaviors.

We were also surprised that financial literacy does not strongly predict whether respondents are more likely to make common investment mistakes with their retirement portfolios. Using self-reports on portfolio allocations, we construct indicators of common "mistakes", based on common investment guidelines used in Mottola and Utkus (2009). The “mistakes” that we look at are (i) holding zero equity, (ii) holding an underdiversified portfolio (i.e., holding only one asset class), (iii) being overly aggressive (holding more than 95% in equity), and (iv) being too conservative (holding less than 40% in equity).

We find that the self-assessed financial literacy indices better predict several financial behaviors than the measured knowledge financial literacy indices do. In particular, the self-assessed indices better predict whether the full employer match is received, whether the maximum possible contribution is made, the frequency with which one checks or changes his portfolio, and whether the respondent has made a plan for spending down his savings during retirement. That the self-assessed financial literacy indices are better than the measured financial literacy indices at predicting these behaviors could result from self-assessments being a better measure of true underlying financial literacy than knowledge tests. Alternatively, these results could stem from a sort of self-presentation bias: respondents may inflate their assessment of their own literacy and inflate what they consider to be desirable financial behavior. More research on comparing self-assessed financial literacy with measured knowledge financial literacy is needed before drawing strong conclusions about which better measures underlying financial literacy and can better predict financial behaviors.

Another area of research that deserves more attention is investigating causality between financial literacy and financial behaviors. In particular, does higher financial literacy lead to better financial decisions? The research presented here does not shed light on causality. We attempted to replicate the instrumental variables strategy used by Lusardi and Mitchell (2009), but we found the instruments to have no predictive power across all measures of financial literacy. However, we believe that causality between financial literacy and financial behaviors is an important research question, the answer to which has important implications for the role of financial education.

References

Agnew, J.R. & Szykman, L.R. (2005). Asset allocation and information overload: The influence of information display, asset choice, and investor experience. *Journal of Behavioral Finance*, *6*, 57-70.

Asparouhov, T., and Muthén, B. O. (2005). Multivariate statistical modeling with survey data. In *Proceedings of the Federal Committee on Statistical Methodology (FCSM) research conference*. Available from http://www.fcsm.gov/05papers/Asparouhov_Muthen_IIA.pdf

Bernheim, D., D. Garrett, and D. Maki (2001). "Education and saving: The long-term effects of high school financial curriculum mandates", *Journal of Public Economics*, 85, 435-565.

Bock, R. D. (1972). Estimating item parameters and latent ability when responses are scored in two or more nominal categories. *Psychometrika*, *37*, 29-51.

Bock, R. D., & Moustaki, I. (2007). Item response theory in a general framework. *Handbook of Statistics*, *26*, 469-513.

Fitzgerald, J., Gottschalk, P., & Moffitt, R. (1998). An analysis of sample attrition in panel data: The Michigan Panel Study of Income Dynamics. *Journal of Human Resources*, *33*, 251-299.

Hilgert, M., Hogarth, J., and Beverley, S. (2003). Household financial management: The connection between knowledge and behavior. Technical report #309-322. *Federal Reserve Bulletin*.

Hung, A. A., Parker, A. M., and J. Yoong (2009). "Defining and Measuring Financial Literacy," working paper.

Lusardi, A., & Mitchell, O.S. (2006). *Financial literacy and planning: Implications for retirement wellbeing*. Wharton School, University of Pennsylvania, Pension Research Council Working Paper n. 1.

Lusardi, A., & Mitchell, O.S. (2007a). Baby boomer retirement security: The roles of planning, financial literacy, and housing wealth. *Journal of Monetary Economics*, *54*, 205-224.

Lusardi, A., & Mitchell, O.S. (2007b). *Financial literacy and retirement planning: New evidence from the RAND American Life Panel*. MRRC Working Paper No. 2007-157.

Lusardi, A., & Mitchell, O.S. (2008). Planning and financial literacy: How do women fare? *American Economic Review: Papers & Proceedings*, *98*, 413-417.

Lusardi and Mitchell (2009). *How Ordinary Consumers Make Complex Economic Decisions: Financial Literacy and Retirement Readiness*. Working Paper.

McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka (Ed.), *Frontiers in econometrics* (pp. 105-142). New York: Academic Press.

Meijer, E., Kapteyn, A., & Andreyeva, T. (2008). *Health indexes and retirement modeling in international comparisons* (Working Paper No. WR-614). Santa Monica, CA: RAND Corporation.

Mottola. Gary R. and Stephen P. Utkus (2009). "Red, Yellow, and Green: Measuring the Quality of 401(k) Portfolio Choices," in A. Lusardi (ed.), "Overcoming the saving slump. How to increase the effectiveness of financial education and saving programs," University of Chicago Press.

Nunnally, J. C. (1978). Psychometric Theory (2nd ed.). New York: McGraw-Hill.

Organisation for Economic Co-operation and Development (OECD) (2005). *Improving financial literacy: Analysis of issues and policies*. Accessed March 11, 2009 at http://titania.sourceoecd.org/vl=4607980/cl=25/nw=1/rpsv/ij/oecdthemes/9998007x/v2005n30/s1/p1l.

Parker, A.M., Yoong, J., Bruine de Bruin, W., Willis, R. (2008, September). *(Over)confidence and economic behavior*. Paper presented at the Conference on Understanding Economic Decision-Making. Jackson, WY.

Rouwendal, J., & Meijer, E. (2001). Preferences for housing, jobs, and commuting: A mixed logit analysis. *Journal of Regional Science*, *41*, 475–505.

Rubin, D. B. (1976). Inference and missing data. *Biometrika*, *63*, 581–592. (with discussion)

Samejima, F. (1979). *A new family of models for the multiple-choice item* (Research Report No. 79-4). Knoxville, TN: University of Tennessee, Department of Psychology.

Thissen, D., & Steinberg, L. (1984). A response model for multiple choice items. *Psychometrika*, *49*, 501-519.

Train, K. E. (2003). *Discrete choice methods with simulation*. Cambridge, UK: Cambridge University Press.

van Rooij, M., Lusardi, A., & Alessie, R. (2007, October). *Financial literacy and stock market participation.* MRRC Working Paper 2007-162.

Wansbeek, T., & Meijer, E. (2000). *Measurement error and latent variables in econometrics*. Amsterdam: North-Holland.

APPENDIX A
Financial knowledge questions

Basic Financial Concept questions[10]

1. Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?
(i) More than $102; (ii) Exactly $102; (iii) Less than $102; (iv) Do not know (DK)

2. Suppose you had $100 in a savings account and the interest rate is 20% per year and you never withdraw money or interest payments. After 5 years, how much would you have on this account in total?
(i) More than $200; (ii) Exactly $200; (iii) Less than $200; (iv) DK

3. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?
(i) More than today; (ii) Exactly the same; (iii) Less than today; (iv) DK

4. Assume a friend inherits $10,000 today and his sibling inherits $10,000 3 years from now. Who is richer because of the inheritance?
(i) My friend; (ii) His sibling; (iii) They are equally rich; (iv) DK

5. Suppose that in the year 2010, your income has doubled and prices of all goods have doubled too. In 2010, how much will you be able to buy with your income?
(i) More than today; (ii) The same; (iii) Less than today; (iv) DK

Questions on investing[11]

1. Which of the following statements describes the main function of the stock market?
(i) The stock market helps to predict stock earnings; (ii) The stock market results in an increase in the price of stocks; (iii) The stock market brings people who want to buy stocks together with those who want to sell stocks; (iv) None of the above; (v) DK

2. Which of the following statements is correct?
(i) Once one invests in a mutual fund, one cannot withdraw the money in the first year; (ii) Mutual funds can invest in several assets, for example invest in both stocks and bonds; (iii) Mutual funds pay a guaranteed rate of return which depends on their past performance; (iv) None of the above; (v) DK

3. If the interest rate falls, what should happen to bond prices?
(i) Rise; (ii) Fall; (iii) Stay the same; (iv) None of the above; (v) DK

4. True or false? Buying a company stock usually provides a safer return than a stock mutual fund.
(i) True; (ii) False; (iii) DK

5. True or false? Stocks are normally riskier than bonds.

[10] Questions are from Lusardi and Mitchell (2006)
[11] Questions 1-8 are from Lusardi and Mitchell (2006); Questions 9-10 are from FINRA Investor Survey; Question 11 from Agnew and Utkus, et al.; Question 12 from Survey of Financial Literacy in WA State; Questions 13-14 from Kimball and Willis

(i) True; (ii) False; (iii) DK

6. Considering a long time period (for example 10 or 20 years), which asset normally gives the highest return?
(i) Savings accounts; (ii) Bonds; or (iii) Stocks; (iv) DK

7. Normally, which asset displays the highest fluctuations over time?
(i) Savings accounts, (ii) Bonds, (iii) Stocks; (iv) DK

8. When an investor spreads his money among different assets, does the risk of losing money:
(i)Increase, (ii) Decrease (iii) Stay the same; (iv) DK

9. If you buy a company's stock…
(i) You own a part of the company, (ii) You have lent money to the company, (iii) You are liable for the company's debts, (iv) The company will return your original investment to you with interest, (v) DK

10. If you buy a company's bond...
(i)You own a part of the company, (ii) You have lent money to the company, (iii) You are liable for the company's debts, (iv) You can vote on shareholder resolutions, (v) DK

11. If you were to invest $1000 in a stock mutual fund, it would be possible to have less than $1000 when you withdraw your money.
(i) True (ii) False (iii) DK

12. A stock mutual fund combines the money of many investors to buy a variety of stocks
(i) True (ii) False (iii) DK

13. It is hard to find mutual funds that have annual fees of less than one percent of assets.
(i) True (ii) False (iii) DK

14. Mutual funds pay a guaranteed rate of return.
(i) True (ii) False (iii) DK

Questions on Life Insurance and Annuities[12]

1. Whole life insurance has a savings feature while term life insurance does not
(i) True (ii) False (iii) DK

2. The cash value of a life insurance policy is the amount available if you surrender your life insurance policy while you're still alive.
(i) True (ii) False (iii) DK

3. An annuity for a specific person pays that person money every year while they are alive, but stops paying money once they are dead.
(i) True (ii) False (iii) DK

4. An annuity is a financial product that pays a lump sum when you die.
(i) True (ii) False (iii) DK

[12] Questions 1-2 are from Agnew, Utkus, et al; Questions 3-4 from Kimball and Willis

Questions on IRA's and 401(k)'s

1. A person who withdraws money from his 401(k) plan after he turns 59 ½ must pay taxes on the money that he withdraws.
(i) True, (ii) False, (iii) It depends on the type of 401(k) plan, (iv) DK

2. A person who withdraws money from her Individual Retirement Account (IRA) plan after she turns 59 ½ must pay taxes on the money that she withdraws.
(i) True, (ii) False, (iii) It depends on the type of IRA, (iv) DK

3. A person who has a defined contribution plan through work (like a 401(k) or 403(b) plan) is not eligible to open or deposit money into an IRA.
(i) True, (ii) False, (iii) It depends on the type of IRA and/or 401(k) plan, (iv) DK

4. There are annual contribution limits on the amount you can save in a 401(k) plan or IRA that depend on your income
(i) True, (ii) False, (iii) It depends on the type of IRA and/or 401(k) plan, (iv) DK

5. If you are undergoing any financial hardship, you will not incur an extra penalty if you withdraw money from a 401(k) plan or IRA before the age of 59 ½.
(i) True, (ii) False, (iii) It depends on the type of IRA and/or 401(k) plan, (iv) DK

6. After age 70 1/2, you have to withdraw at least some money from your 401(k) plan or IRA.
(i) True, (ii) False, (iii) It depends on the type of IRA and/or 401(k) plan, (iv) DK

Table 1: Weighted and unweighted composition of the total sample and regression sample.

	Complete sample (%)		Regression sample (%)	
	unweighted	weighted	unweighted	weighted
Age		%	%	%
18 to 29	6.5	11.5	4.3	5.9
30 to 44	16.9	21.5	23.5	29.3
45 to 59	45.4	38.3	61.4	56.3
60 plus	31.3	28.7	10.9	8.5
Gender				
male	44.7	45.6	51.4	51.2
female	55.3	54.4	48.6	48.8
Race/ethnicity				
hispanic	3.2	7.4	3.6	8.5
black	5.9	11.4	4.9	7.5
other	91.0	81.1	91.5	84.0
Marital status				
married	66.5	58.3	70.6	65.5
unmarried	33.5	41.7	29.4	34.5
Education				
HS or less	15.4	36.4	10.7	26.5
More than HS	84.6	63.6	89.3	73.5
Labor force participation				
employed	63.7	62.6	100.0	100.0
retired	26.5	25.7		
not employed	9.8	11.7		
Income				
< $50,000	35.0	39.9	16.9	17.8
>= $50,000	65.0	60.1	83.1	82.2
N	1547	1547	469	469

Table 2: Fit statistics for the measurement models.

	Model (underlying dimensions)		
	Null (0)	General (1)	Subdomains (3)
Sample size	1547	1547	1547
Log pseudo-likelihood	-43280.82	-23085.25	-22860.71
No. parameters	46	92	95
Scaled LR test		15055.75	15517.86 (w.r.t. (0)) 242.67 (w.r.t. (1))
p-value		0	0 (w.r.t. (0)) 2.5e-52 (w.r.t. (1))
AIC	86607.63	46354.50	45911.42
BIC	86730.54	46846.15	46419.11
Pseudo-R^2	0	.467	.472

Table 3: Estimation results for the measurement models for financial literacy.

	General (1-dimensional)				Subdomains (3-dimensional)			
	Correct		Incorrect		Correct		Incorrect	
	β	α	β	α	β	α	β	α
Basic								
Numeracy	2.55	4.95	1.93	2.67	4.74	7.38	3.63	4.97
s.e.	0.50	0.52	0.46	0.54	1.45	1.61	1.30	1.60
CompoundInt	2.87	4.75	1.85	3.79	5.06	7.09	3.69	6.10
s.e.	0.56	0.55	0.50	0.56	1.57	1.71	1.45	1.73
Inflation	2.50	3.64	1.30	1.56	3.69	4.54	2.02	2.33
s.e.	0.36	0.34	0.35	0.36	0.59	0.52	0.54	0.54
TimeValue	1.22	1.86	0.42	1.20	1.36	1.85	0.45	1.21
s.e.	0.25	0.15	0.24	0.16	0.30	0.17	0.27	0.17
MoneyIllusion	1.86	4.37	1.57	2.98	2.30	4.68	1.87	3.30
s.e.	0.43	0.46	0.43	0.47	0.53	0.58	0.53	0.59
Investment								
StockMkt	2.83	2.91	1.92	1.98	2.95	2.83	1.99	1.93
s.e.	0.32	0.26	0.30	0.26	0.32	0.30	0.31	0.28
MutualFund	3.51	1.70	2.16	0.38	3.81	1.67	2.37	0.39
s.e.	0.37	0.22	0.37	0.22	0.41	0.26	0.42	0.23
Bonds	1.99	0.44	1.05	0.80	2.06	0.37	1.07	0.77
s.e.	0.24	0.14	0.17	0.12	0.28	0.16	0.18	0.12
Safer	3.24	2.57	1.84	0.15	3.52	2.56	2.01	0.18
s.e.	0.34	0.23	0.35	0.26	0.35	0.27	0.35	0.27
Riskier	2.55	2.98	1.33	0.14	2.76	2.99	1.52	0.20
s.e.	0.32	0.29	0.53	0.35	0.33	0.33	0.54	0.36
Returns	3.64	2.69	2.19	1.93	3.81	2.59	2.27	1.87
s.e.	0.37	0.26	0.33	0.26	0.38	0.30	0.32	0.26
Flucutate	3.48	4.11	2.39	1.47	3.63	4.02	2.51	1.41
s.e.	0.54	0.51	0.52	0.54	0.53	0.54	0.52	0.55
RiskDiv	3.46	3.93	2.03	2.30	3.55	3.79	2.07	2.20
s.e.	0.45	0.41	0.37	0.40	0.44	0.44	0.36	0.42
CompanyStock	2.63	3.47	1.72	1.91	2.75	3.40	1.78	1.86
s.e.	0.34	0.32	0.34	0.32	0.35	0.33	0.35	0.32
CompanyBond	3.00	1.25	1.48	-0.20	3.04	1.16	1.51	-0.25
s.e.	0.29	0.17	0.28	0.18	0.30	0.20	0.28	0.18
Withdraw	3.22	3.50	2.01	1.04	3.47	3.51	2.24	1.09
s.e.	0.36	0.29	0.40	0.32	0.35	0.32	0.35	0.33
StockFundKnow	3.20	2.60	1.17	-1.52	3.39	2.56	1.41	-1.44
s.e.	0.35	0.24	0.77	0.47	0.38	0.27	0.65	0.40
MutualFundKnow	1.48	-1.31	0.87	-0.96	1.57	-1.38	0.90	-0.98
s.e.	0.21	0.15	0.13	0.10	0.21	0.16	0.13	0.11
MutualFundRate	3.64	2.06	2.18	0.36	3.98	2.05	2.40	0.39
s.e.	0.53	0.27	0.41	0.30	0.53	0.30	0.41	0.30
Risk Management								
LifeInsSave	1.57	0.75	0.46	-1.63	1.92	0.80	1.47	-1.48
s.e.	0.16	0.11	0.29	0.17	0.28	0.13	0.22	0.21
CashValueLI	1.43	1.55	0.67	0.11	2.17	1.87	1.40	0.50
s.e.	0.19	0.12	0.19	0.15	0.29	0.19	0.24	0.20
AnnuityYearly	1.16	0.37	0.93	-0.38	2.73	0.70	2.62	-0.06
s.e.	0.15	0.10	0.17	0.12	0.48	0.21	0.49	0.22
AnnuityLumSum	1.43	0.43	0.83	-0.53	3.35	0.80	2.73	-0.03
s.e.	0.17	0.10	0.18	0.12	0.61	0.25	0.60	0.26

Table 4: Estimated correlations between underlying dimensions in the subdomain model.

Dimension	BF	IN	RM
BF	1.00		
s.e.	(fixed)		
IN	0.90	1.00	
s.e.	0.03	(fixed)	
RM	0.57	0.71	1.00
s.e.	0.06	0.05	(fixed)

Table 5: Fit statistics for the self-assessment measurement model.

	Model (underlying dimensions)		
	Null (0)	General (1)	Subdomains (2)
Sample size	1547	1547	1547
Log pseudo-likelihood	-22025.5	-17854.2	-17740.2
No. parameters	67	86	93
Scaled LR test		2949.28	3216.62 (w.r.t. (0)) 102.79 (w.r.t. (1))
p-value		0	0 (w.r.t. (0)) 2.9e-19 (w.r.t. (1))
AIC	44184.97	35880.45	35666.35
BIC	44543.02	36340.04	36163.35
Pseudo-R^2	0	0.189	0.195

Table 6: Estimation results for the one-dimensional measurement model for self-assessed financial literacy.

	Factor	Threshold					
Indicator	Loading	1	2	3	4	5	6
KnowEcon	1.00	0.00	1.08	1.94	3.01	4.23	5.60
s.e.	(fixed)	(fixed)	0.11	0.13	0.14	0.16	0.25
KnowMath	-0.52	-2.58	-1.21	-0.38	0.00	0.64	
s.e.	0.05	0.17	0.14	0.14	0.13	0.13	
KnowStocks	-2.25	-10.68	-7.98	-5.95	-5.05	-3.07	
s.e.	0.22	0.99	0.69	0.57	0.53	0.44	
LikeStock	-1.38	-6.61	-5.05	-3.86	-3.27	-2.14	
s.e.	0.13	0.42	0.37	0.33	0.31	0.28	
KnowInvest	-2.23	-10.99	-8.11	-6.15	-4.99	-3.32	
s.e.	0.25	1.21	0.91	0.74	0.66	0.55	
KnowInvestType	-2.00	-9.55	-6.84	-4.95	-4.13	-2.73	
s.e.	0.18	0.63	0.51	0.45	0.42	0.37	
KnowMFFees	-1.31	-6.32	-4.36	-3.05	-2.45	-1.22	
s.e.	0.11	0.39	0.33	0.29	0.28	0.26	
FirstInvKnowFee	-1.01	-5.26	-3.66	-2.52	-1.96	-0.86	
s.e.	0.09	0.34	0.29	0.26	0.25	0.23	
CertMFFee	-0.84	-4.80	-3.79	-2.74	-1.77		
s.e.	0.08	0.31	0.27	0.24	0.22		
CertLoadPerc	-0.83	-4.99	-3.76	-2.82	-1.80		
s.e.	0.11	0.41	0.37	0.32	0.29		
KnowEmpPlan	1.06	0.18	1.04	1.71	2.57	3.61	4.89
s.e.	0.10	0.28	0.26	0.26	0.28	0.31	0.37
KnowPlanEnroll	0.90	0.69	1.36	2.05	2.91	3.74	4.66
s.e.	0.11	0.29	0.30	0.32	0.33	0.37	0.47
KnowDCPlanFee	0.80	0.98	1.58	2.23	3.16	3.95	4.77
s.e.	0.11	0.30	0.30	0.32	0.32	0.35	0.39

Predictive equation for self-assessed financial literacy

Covariate	Coeff.
InvestStockMF	0.62
s.e.	0.09
InvestStockNow	0.66
s.e.	0.08
mf_load	-0.27
s.e.	0.08
EmpbyOther	-0.20
s.e.	0.08
DCElig	-0.05
s.e.	0.16
DCEnroll	0.22
s.e.	0.17
Constant	2.11
s.e.	0.14
Residual variance	0.88
s.e.	0.12

Table 7: Estimation results for the two-dimensional measurement model for self-assessed financial literacy.

	Factor Loading		Threshold					
Indicator	Basic	Cont	1	2	3	4	5	6
KnowEcon	1.00		0.00	1.07	1.93	3.01	4.22	5.60
s.e.	(fixed)		(fixed)	0.11	0.12	0.14	0.16	0.25
KnowMath	-0.52		-2.57	-1.20	-0.38	0.00	0.64	
s.e.	0.05		0.16	0.14	0.14	0.13	0.13	
KnowStocks	-2.32		-10.96	-8.21	-6.11	-5.18	-3.16	
s.e.	0.25		1.13	0.78	0.63	0.58	0.47	
LikeStock	-1.40		-6.68	-5.11	-3.90	-3.31	-2.16	
s.e.	0.13		0.44	0.38	0.34	0.32	0.28	
KnowInvest	-2.30		-11.26	-8.34	-6.32	-5.13	-3.42	
s.e.	0.28		1.33	1.01	0.81	0.73	0.60	
KnowInvestType	-2.02		-9.65	-6.91	-4.99	-4.17	-2.75	
s.e.	0.18		0.63	0.52	0.45	0.42	0.38	
KnowMFFees		-1.68	-8.39	-5.90	-4.21	-3.42	-1.82	
s.e.		0.26	0.97	0.81	0.72	0.67	0.57	
FirstInvKnowFee		-1.30	-6.85	-4.89	-3.48	-2.78	-1.43	
s.e.		0.20	0.72	0.62	0.55	0.51	0.46	
CertMFFee		-0.74	-4.64	-3.62	-2.57	-1.62		
s.e.		0.10	0.39	0.34	0.31	0.29		
CertLoadPerc		-0.75	-4.86	-3.65	-2.70	-1.69		
s.e.		0.12	0.47	0.42	0.38	0.34		
KnowEmpPlan		1.00	0.00	0.91	1.63	2.52	3.58	4.88
s.e.		(fixed)	(fixed)	0.20	0.22	0.23	0.26	0.31
KnowPlanEnroll		0.93	0.76	1.47	2.21	3.12	3.98	4.96
s.e.		0.12	0.27	0.30	0.32	0.35	0.39	0.51
KnowDCPlanFee		0.86	1.17	1.81	2.50	3.50	4.35	5.24
s.e.		0.12	0.30	0.32	0.34	0.35	0.39	0.45

Predictive equations for self-assessed financial literacy

	Coeff	
Covariate	Basic	Cont
InvestStockMF	0.58	0.72
s.e.	0.10	0.17
InvestStockNow	0.71	0.53
s.e.	0.08	0.11
mf_load	-0.24	-0.28
s.e.	0.08	0.10
EmpbyOther	-0.19	-0.20
s.e.	0.09	0.12
DCElig	-0.03	-0.41
s.e.	0.17	0.25
DCEnroll	0.22	0.49
s.e.	0.17	0.24
Constant	2.09	2.28
s.e.	0.14	0.26
Residual variance	0.86	1.15
s.e.	0.11	0.23
Residual covariance	0.86	
s.e.	0.12	

Table 8: Distributions of the indices.

				Correlations							
Index	*N*	Mean	s.d.	MFL	BF	IN	RM	SAFL	Basic	Cont	Reliability
Measured Financial Literacy	1,547	0.03	0.89	1.00							0.87
Measured Basic Financial Literacy	1,547	0.05	0.81	0.96	1.00						0.75
Measured Investment Literacy	1,547	0.06	0.87	0.99	0.96	1.00					0.86
Measured Risk Management Literacy	1,547	0.06	0.81	0.83	0.70	0.80	1.00				0.73
Self-Assessed Financial Literacy	1,547	2.50	1.00	0.67	0.64	0.68	0.55	1.00			0.94
Self-Assessed Basic Skills Literacy	1,547	2.50	1.00	0.67	0.64	0.68	0.55	1.00	1.00		0.93
Self-Assessed Contextual Literacy	556	2.74	1.07	0.54	0.51	0.55	0.35	0.96	0.93	1.00	0.90

Table 9: Mean values of the indices in subpopulations.

	Measured Financial Literacy	Measured Basic Financial Literacy	Measured Investment Literacy	Measured Risk Management Literacy	Self-Assessed Financial Literacy	Self-Assessed Basic Skills Literacy	Self-Assessed Contextual Literacy
Age							
18 to 29	-0.49	-0.40	-0.41	-0.43	2.02	2.02	2.39
s.e.	(0.09)	(0.09)	(0.08)	(0.09)	(0.12)	(0.12)	(0.24)
30 to 44	-0.13	-0.06	-0.09	-0.15	2.41	2.42	2.76
s.e.	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.09)	(0.12)
45 to 59	0.08	0.10	0.11	0.14	2.52	2.51	2.74
s.e.	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.09)
60 plus	0.29	0.27	0.30	0.32	2.74	2.72	2.97
s.e.	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)	(0.12)
Gender							
Male	0.36	0.37	0.38	0.27	2.86	2.86	3.04
s.e.	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.09)
Female	-0.24	-0.21	-0.21	-0.11	2.20	2.19	2.43
s.e.	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.09)
Race/ethnicity							
hispanic	-0.40	-0.33	-0.35	-0.20	2.15	2.13	2.24
s.e.	(0.16)	(0.13)	(0.15)	(0.15)	(0.15)	(0.15)	(0.25)
Black	-0.48	-0.50	-0.44	-0.15	2.18	2.17	2.52
s.e.	(0.12)	(0.11)	(0.12)	(0.12)	(0.12)	(0.12)	(0.17)
Other	0.14	0.17	0.17	0.12	2.58	2.58	2.84
s.e.	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.07)
Marital status							
married	0.19	0.20	0.21	0.19	2.64	2.63	2.77
s.e.	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.08)
unmarried	-0.19	-0.15	-0.15	-0.11	2.31	2.31	2.68
s.e.	(0.06)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)	(0.10)
Education							
HS or less	-0.32	-0.30	-0.29	-0.12	2.13	2.12	2.20
s.e.	(0.07)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.16)
More than HS	0.23	0.26	0.26	0.17	2.72	2.71	2.94
s.e.	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.06)
Labor force participation							
employed	0.04	0.06	0.07	0.04	2.51	2.51	2.72
s.e.	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.07)
Retired	0.22	0.20	0.24	0.28	2.70	2.69	3.08
s.e.	(0.07)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)	(0.16)
not employed	-0.41	-0.32	-0.35	-0.27	2.04	2.03	2.75
s.e.	(0.09)	(0.09)	(0.09)	(0.08)	(0.11)	(0.11)	(0.31)
Income							
< $50,000	-0.33	-0.30	-0.29	-0.15	2.22	2.22	2.32
s.e.	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.12)
>= $50,000	0.27	0.29	0.30	0.20	2.69	2.68	2.86
s.e.	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.07)

Table 10: Decumulation Planning

Panel A

Have you ever tried to figure out how much your household would be able to withdraw from your savings every year in retirement?	
Yes 28.1%	No 71.2%

Have you made a plan for systematically spending down your savings during retirement?	
Yes 43.2%	No 56.8%

Are you confident that your retirement spending plan will be sufficient to ensure that your needs are met in the future?	
Yes 33.3%	No 66.7%

Panel B

Question	*Proportion of Sample*
Simple Planners Yes to "Tried to figure out how much to withdraw from savings every year in retirement"	28.1%
Serious Planners Replied yes to "Developed a plan"	12.5%
Successful Planners Replied yes to "Future plan meets needs"	4.1%

Table 11: OLS Regression estimates of Retirement Planning on Financial Literacy

	(1) Think about retirement	(2) Total dollar amount in DC plan	(3) Total retirement savings
Measured Financial Literacy	0.306***	3.173	26.460
s.e.	(0.067)	(6.006)	(18.396)
N	468	438	423
R^2	0.15	0.10	0.06
Measured Basic Financial Literacy	0.237***	4.425	34.009
s.e.	(0.078)	(6.390)	(23.505)
N	468	438	423
R^2	0.12	0.10	0.06
Measured Investment Literacy	0.300***	4.277	32.512
s.e.	(0.071)	(6.253)	(19.731)
N	468	438	423
R^2	0.14	0.10	0.06
Measured Risk Management Literacy	0.344***	4.943	13.741
s.e.	(0.057)	(5.531)	(21.056)
N	468	438	423
R^2	0.17	0.10	0.06
Self-Assessed Financial Literacy	0.241***	5.454	21.884
s.e.	(0.064)	(3.762)	(13.890)
N	468	438	423
R^2	0.15	0.10	0.06
Self-Assessed Basic Skills Literacy	0.242***	5.508	23.276*
s.e.	(0.062)	(3.737)	(13.932)
N	468	438	423
R^2	0.15	0.10	0.06
Self-Assessed Contextual Literacy	0.206***	4.547	12.208
s.e.	(0.063)	(3.830)	(16.115)
N	381	358	348
R^2	0.14	0.09	0.06

Note: Demographic controls for gender, ethnicity, income, age, education and marital status not shown

Table 12: OLS regression estimates of 2008 DC plan behavior on financial literacy

	(1) Contributed to DC plan	(2) % of salary withheld	(3) Total dollar contribution	(4) Received full employer match	(5) Made maximum contribution
Measured Financial Literacy	0.015	1.255	0.154**	0.064*	-0.011
s.e.	(0.022)	(1.151)	(0.074)	(0.039)	(0.042)
N	445	448	449	346	422
R^2	0.04	0.03	0.11	0.06	0.03
Measured Basic Financial Literacy	0.031	1.238	0.179**	0.076	-0.016
s.e.	(0.024)	(0.886)	(0.081)	(0.047)	(0.046)
N	445	448	449	346	422
R^2	0.04	0.03	0.11	0.06	0.03
Measured Investment Literacy	0.019	1.290	0.183**	0.067	-0.012
s.e.	(0.023)	(0.997)	(0.076)	(0.041)	(0.043)
N	445	448	449	346	422
R^2	0.04	0.03	0.12	0.06	0.03
Measured Risk Management Literacy	-0.000	1.021	0.107	0.054*	0.004
s.e.	(0.023)	(1.361)	(0.082)	(0.030)	(0.037)
N	445	448	449	346	422
R^2	0.03	0.03	0.11	0.05	0.03
Self-Assessed Financial Literacy	0.004	0.325	0.140**	0.056**	0.093***
s.e.	(0.018)	(0.556)	(0.059)	(0.028)	(0.030)
N	445	448	449	346	422
R^2	0.03	0.03	0.12	0.06	0.05
Self-Assessed Basic Skills Literacy	0.004	0.186	0.149**	0.056**	0.090***
s.e.	(0.017)	(0.679)	(0.060)	(0.028)	(0.031)
N	445	448	449	346	422
R^2	0.03	0.03	0.12	0.06	0.05
Self-Assessed Contextual Literacy	0.012	0.724**	0.093	0.047	0.101***
s.e.	(0.016)	(0.322)	(0.058)	(0.029)	(0.028)
N	363	366	367	287	350
R^2	0.04	0.09	0.11	0.06	0.06

Note: Demographic controls for gender, ethnicity, income, age, education and marital status not shown

Table 13: OLS regression estimates of investment mistakes and portfolio churning on financial literacy

	(1) Zero equity	(2) Under-diversified	(3) Too aggress.	(4) Too conserv.	(5) Check frequently	(6) Change frequently
Measured Financial Literacy	0.038	-0.035	-0.074*	-0.029	0.025	-0.006
s.e.	(0.038)	(0.050)	(0.042)	(0.050)	(0.042)	(0.049)
N	376	376	376	376	381	381
R^2	0.06	0.06	0.07	0.14	0.07	0.05
Measured Basic Financial Literacy	0.036	0.001	-0.024	-0.053	0.013	-0.007
s.e.	(0.042)	(0.052)	(0.042)	(0.054)	(0.044)	(0.052)
N	376	376	376	376	381	381
R^2	0.06	0.05	0.06	0.15	0.07	0.05
Measured Investment Literacy	0.029	-0.041	-0.066	-0.038	0.030	-0.009
s.e.	(0.038)	(0.051)	(0.043)	(0.052)	(0.043)	(0.050)
N	376	376	376	376	381	381
R^2	0.06	0.06	0.07	0.14	0.07	0.05
Measured Risk Management Literacy	0.042*	-0.039	-0.099**	-0.003	0.026	-0.006
s.e.	(0.024)	(0.041)	(0.040)	(0.044)	(0.038)	(0.036)
N	376	376	376	376	381	381
R^2	0.07	0.06	0.08	0.14	0.07	0.05
Self-Assessed Financial Literacy	-0.015	-0.041	-0.015	-0.010	0.122***	0.090***
s.e.	(0.026)	(0.040)	(0.040)	(0.041)	(0.037)	(0.033)
N	376	376	376	376	381	381
R^2	0.06	0.06	0.06	0.14	0.11	0.08
Self-Assessed Basic Skills Literacy	-0.018	-0.040	-0.012	-0.023	0.124***	0.093***
s.e.	(0.027)	(0.041)	(0.040)	(0.041)	(0.036)	(0.033)
N	376	376	376	376	381	381
R^2	0.06	0.06	0.06	0.14	0.11	0.09
Self-Assessed Contextual Literacy	-0.017	-0.054	-0.025	0.020	0.112***	0.087***
s.e.	(0.025)	(0.038)	(0.039)	(0.038)	(0.035)	(0.030)
N	318	318	318	318	323	323
R^2	0.07	0.07	0.06	0.16	0.11	0.10

Note: Demographic controls for gender, ethnicity, income, age, education and marital status not shown

Table 14: OLS Regression estimates of decumulation planning on financial literacy

	(1) Figure out how to withdraw	(2) Made a plan	(3) Plan meets needs
Measured Financial Literacy	0.176***	0.028	0.029**
s.e.	(0.043)	(0.034)	(0.015)
N	465	465	465
R^2	0.19	0.08	0.05
Measured Basic Financial Literacy	0.181***	0.026	0.032**
s.e.	(0.045)	(0.037)	(0.015)
N	465	465	465
R^2	0.18	0.08	0.05
Measured Investment Literacy	0.179***	0.029	0.028*
s.e.	(0.044)	(0.036)	(0.015)
N	465	465	465
R^2	0.18	0.08	0.04
Measured Risk Management Literacy	0.142***	0.058***	0.029**
s.e.	(0.033)	(0.021)	(0.013)
N	465	465	465
R^2	0.17	0.10	0.05
Self-Assessed Financial Literacy	0.156***	0.071***	0.030**
s.e.	(0.028)	(0.023)	(0.012)
N	465	465	465
R^2	0.20	0.11	0.05
Self-Assessed Basic Skills Literacy	0.153***	0.069***	0.028**
s.e.	(0.028)	(0.023)	(0.011)
N	465	465	465
R^2	0.20	0.11	0.05
Self-Assessed Contextual Literacy	0.136***	0.071***	0.036**
s.e.	(0.028)	(0.025)	(0.014)
N	379	379	379
R^2	0.22	0.14	0.07

Note: Demographic controls for gender, ethnicity, income, age, education and marital status not shown