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Using the Right Yardstick: Assessing Financial Literacy Measures by Way of Financial Well-Being

Despite the proliferation of academic studies examining financial literacy and financial outcomes, no consistent definition or empirically validated measures of financial literacy exist. While a handful of questions have become the standard measures of financial literacy in previous research, little work has been done examining whether responses to these questions accurately capture underlying financial capability, or whether they causally relate to subsequent financial well-being. Taking advantage of longitudinal data from the Health and Retirement Study we examine whether some of the questions previously used as measures of financial literacy are consistent measures of financial knowledge and effective predictors of future changes in wealth. We find that respondents frequently do not consistently answer questions across survey waves and that the context in which a question is asked affects the likelihood of correctly responding. Moreover, our regression analyses suggest that correctly answering these questions, consistently or not, has little significant relationship to changes in wealth over time, and is often related to a decrease in future wealth. Our findings should give pause to researchers using the financial literacy questions examined here, particularly from cross-sectional data.

Household financial well-being is increasingly determined by the ability of the family members to make complex financial decisions. Following the broad move from defined benefit to defined contribution plans, financial well-being in retirement is now increasingly dependent on effective management of savings and portfolio allocation decisions across both career (accumulation) and retirement (draw down) phases of life. More broadly, the recent financial crisis highlighted the perils

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The Journal of Consumer Affairs, Summer 2013: 243–262
DOI: 10.1111/joca.12010
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of a large number of individuals making poorly informed decisions about complex mortgage products. Consequently, people's ability to make effective decisions about the use and management of their income, financial products, and investment portfolios is drawing growing attention from educators, businesses, community organizations, and government agencies (Hilgert, Hogarth, and Beverly 2003; President's Advisory Council on Financial Capability 2012). Policymakers are concerned that a substantial proportion of consumers lack basic financial knowledge and money-managing capacities, which are indispensable for them to ensure and enhance the financial well-being of their families.

A number of recent studies have found low levels of "financial literacy" in the American population (Lusardi and Mitchell 2007; Lusardi, Mitchell, and Curto 2010; Lusardi 2008; Hilgert, Hogarth, and Beverly 2003). Despite the proliferation of research examining the relationship between "financial literacy" and financial well-being, no standardized definition of financial literacy exists, and current measures of financial literacy have not been empirically validated as *causal* predictors of subsequent financial well-being or financial behavior (Huston 2010; Hung, Parker, and Yoong 2009). Additionally, high scores on current metrics have not been shown to predict long-term financial well-being or resilience to financial shocks. However, recent efforts have been made to develop a financial knowledge scale by relating a core set of existing financial literacy questions to underlying financial knowledge using psychometric analysis (Knoll and Houts 2012).

The bulk of existing financial literacy questions relate to knowledge of investing or involve numerical calculations. While knowledge of optimal portfolio allocation, relative asset returns, and asset risk may be salient to the financial well-being of higher socio-economic status respondents who possess 401(k) and brokerage accounts, the majority of the population does not make these types of investment decisions. It is unclear if these questions relate to an individual's ability to successfully navigate their day-to-day personal finances once demographics and other characteristics are adequately controlled for (Warmath and Elwert 2012). Moreover, given the emphasis these questions place on one's mathematical ability, it is unclear if they distinguish between actual financial capability and simple numeracy skill, which by itself is a strong predictor of income and assets (Kozup and Hogarth 2008; Gerardi, Goette, and Meier 2010).

Using longitudinal data on responses to financial literacy questions and detailed information on respondent assets available in four recent waves (2002–2008) of the Health and Retirement Study (HRS), we examine the consistency of responses to financial literacy questions across survey

waves and across different ways of asking the same fundamental question. We further analyze the extent to which correctly responding to the existing questions is correlated with changes in wealth over time. We find that many respondents do not answer the exact same financial literacy questions consistently across HRS waves, and often switch from correct to incorrect responses. Moreover, a question's framing (i.e., positive response or negative response is the correct one) and context (i.e., asked to perform straight mathematical calculations versus a question posed in the context of calculating the incidence of disease) appears to result in statistically significant differences in the probability of a respondent answering correctly. Lastly, the financial literacy questions examined do not appear to be related to changes in wealth once other factors are controlled for in a regression context. Thus researchers must carefully select the questions used to assess financial literacy, and how responses are interpreted, particularly in cross-sectional data.

BACKGROUND

Several recent studies have highlighted the ambiguous usage of the term financial literacy. Huston (2010) provided a summary of the broad range of financial literacy measures used in the last decade, including the definitions of financial literacy. She found that the terms financial literacy, financial knowledge, and financial education are often used interchangeably. Similarly, Remund (2010) provided an analysis of the many ways in which financial literacy has been defined and measured in an attempt to provide a clear and consistent definition. Robb (2012) provides a particularly thorough examination of the different definitions of financial literacy used in the literature, as well as the various questions used to measure financial literacy. Huston, Remund, and Robb conclude that there is currently no standardized instrument to measure financial literacy, however it is defined. Robb (2012) emphasizes that this lack of a consistent measure of financial literacy limits the extent to which the findings from research on financial literacy can be used to track changes in financial literacy in the broader population, or to evaluate the relative effectiveness of financial literacy interventions. Robb (2012) further highlights that there is a distinction between the concepts of financial knowledge and financial literacy, but these terms are often used interchangeably in existing research. He distinguishes between the two terms by stating that financial literacy involves an ability to understand financial information and make effective decisions using that information, while knowledge is simply recalling a set of facts.

Nonetheless, the lack of a standardized set of financial literacy measures and consistent definition has not prevented the emergence of a significant body of literature that examines the relationship between financial knowledge and various measures of financial well-being. For example, various researchers have found that correct responses to the HRS financial literacy questions are correlated with retirement planning, wealth, and financial well-being in retirement (Lusardi 2008; Hung, Parker, and Yoong 2009; Lusardi and Mitchell 2007). Gerardi, Goette, and Meier (2010) examined the independent effects of numerical ability (an element of financial literacy) and correctly responding to the Lusardi and Mitchell (2009) sequence of financial literacy questions related to mortgage delinquency. The authors found a large and significant negative relationship between numerical ability and delinquency, but no significant effect of correctly answering the financial literacy questions. Similarly, Agarwal and Mazumder (2013) document that math ability is positively related to the optimal use of credit card balance transfers and to accepting a higher interest rate on a home equity loan or home equity line of credit than they are entitled to.

Tourangeau, Rips and Rasinski (2000) documented that numeracy, context and cognitive effort interact with an individual's ability to comprehend a question, retrieve relevant information, use the retrieved information to form a response, and select the appropriate answer. Thus individuals with high numeracy skills may be more likely than low-numeracy respondents to correctly answer financial literacy questions. Given the strong relationship between numeracy and financial well-being, research that examines the relationship between correctly responding to financial literacy questions and financial outcomes that excludes a measure of numeracy may yield biased estimates.

Given the relatively recent emergence of financial literacy research, the questions in use have not been rigorously tested to ensure that they are accurately measuring the respondent's underlying level of financial ability as opposed to other factors, such as numeracy, that are correlated with financial outcomes. Moreover, the exact wording, framing, and context of these questions have not been tested to ensure that respondents are correctly interpreting these questions and responding consistently to them. There is significant evidence that these factors can influence a respondent's ability to correctly answer questions, thus potentially biasing estimates of the effect of financial literacy on financial outcomes. Fowler (1995) documented that the exact phrasing of a question can alter how individuals respond. He also emphasizes the importance of verifying the consistency of responses to survey questions both across respondents

and for any one respondent over time. Notably, he points out that inconsistencies over time can be taken as a conservative estimate of error in one or more of the responses because, "there are forces—including recall of the original answer—that would push respondents toward repeating, . . . , answers" (p. 147).

There has been some limited evidence presented in financial literacy research on the effect of question wording on response patterns. In particular, Lusardi and Mitchell (2009) examined the relationship between financial literacy and retirement outcomes using data from RAND's American Life Panel (ALP). Somewhat tangential to the aims of the paper, they also attempt to see if people understand three of the financial literacy questions asked as a part of the ALP. For the true/false question "Stocks are normally riskier than bonds" they find that inverting the order of the words "stock" and "bond" does not yield different results. However, inverting the words "company stock" and "stock mutual fund" in the question "Buying a company stock usually provides a safer return than a stock mutual fund" yields a different percentage of correct answers. Given these well-known issues with responses to survey questions, we explore the extent to which the financial literacy questions collected in the HRS are subject to these response biases. We further explore whether the consistency with which respondents correctly answer questions over time yields a more effective measure of financial outcomes than when a question is correctly answered at a single point in time, as Fowler (1995) suggests.

DATA

Our data come from the HRS, a longitudinal survey run by the University of Michigan. The "original HRS" was first administered in 1992 and used a sample of persons born from 1931 to 1941 and their spouses. The HRS is a longitudinal data set and re-interviews its subjects every two years. Every six years, new respondents in their early 50s, known as "refresher cohorts," are added to the sample to ensure that the overall sample is representative of the country as a whole. Interview subjects stay in the sample until their death. The HRS collects extremely detailed information on respondent demographics, assets, health, health care, housing, income, and employment.

Aside from the information collected every survey, the HRS also includes modules that focus on specific themes but are not part of the base questionnaire and are not asked of the whole sample. In 2002, a module of numeracy questions and risk assessment questions were added

to the survey. In addition, a large subsample of the HRS population (14,648 respondents) was given a three-item financial literacy quiz. The questions were:

1. *If the chance of getting a disease is 10 percent, how many people out of 1,000 would be expected to get the disease?*
2. *If 5 people all have the winning number in the lottery and the prize is $2 million, how much will each of them get?*
3. *Let's say you have $200 in a savings account. The account earns 10% interest per year. How much would you have in the account at the end of two years?*

These financial literacy questions were also included in the 2004 and 2006 surveys; however, only 3,202 people were given this module in 2004, compared with approximately 15,000 in 2006. There are approximately 11,900 respondents who answered these financial literacy questions both in 2002 and 2006, allowing us to examine a respondent's pattern of correct and incorrect responses to identical questions across survey waves. We are further able to examine whether consistent and accurate responses are correlated with financial well-being.

Table 1 details the number of respondents that were exposed to the relevant HRS modules, how many were asked the question in a given wave, and how many were repeatedly asked a given set of questions. As can be seen here, the number of respondents varies widely depending on the particular questions and time period examined, and, therefore, so too does our sample size depending on the particular analysis being conducted.

DESCRIPTIVE ANALYSIS

We begin our analysis of the financial literacy questions used in the HRS by examining whether the context in which the questions are asked affects the likelihood that respondents will correctly answer the questions. To be considered a good measure of underlying financial capability, the particular wording of the question, or framing, should not affect the response. In addition, answers should be reflective of the respondent's actual financial knowledge. In the HRS, many questions are asked in a variety of different contexts to assess whether these have any effect on response patterns. Thus we can examine whether or not the rate of correct response is affected by the manner in which the question is posed, and whether any difference in response rates relates to financial well-being.

TABLE 1
Repeated Questioning of Subsamples in HRS Modules: Cell Counts (N*) 2002–2008*

	Numeracy (percents) 2002	Risk 2002	Stock 2004	Risk 2004	Annuity/ social security 2004	Retirement 2006	Risk 2006	Econ/invest 2008	Fin lit 2002	Fin lit 2004	Fin lit 2006	Fin lit 2008
Numeracy (percents) 2002	1,061											
Risk 2002	0	1,244										
Stock 2004	0	0	1,007									
Risk 2004	74	93	74	1,235								
Annuity/social security 2004	54	61	56	0	1,058							
Retirement 2006	87	11	77	126	105	1,562						
Risk 2006	11	796	7	116	105	0	1,404					
Econ/investments 2008	96	95	75	44	35	127	120	1,517				
Financial literacy 2002	890	1,072	1,048	881	504	1,048	911	976	14,648			
Financial literacy 2004	3	7	8	196	371	277	279	303	71	3,388		
Financial literacy 2006	887	1,057	860	1,113	966	1,550	1,393	1,439	11,902	2,949	17,570	
Financial literacy 2008	3	6	1	4	9	9	9	8	34	48	80	124

TABLE 2
Asset Levels and Changes Based on Answers to Questions Differentiated by Difficulty and Context

Question Kernel		Comparability (p-Value)		Assets (Ratio: Incorrect/Correct)	
Context	Percent Correct	vs. *-B-*	vs. *-C-*	Mean (1992–2008)	Change (1992–2008)
-I- What is 15% of 1,000?					
-A-: Math	82%	20.2%	12.0%	25.2%**	34.4%**
-B-: Medicine	62%	-	8.2%*	26.0%***	3.0%***
-C-: Shopping	70%		-	38.3%***	36.5%***
-II- The number 10 is what percent of 1,000?					
-A-: Math	45%	17.1%	9.0%*	76.4%	52.7%
-B-: Medicine	28%	-	26.1%	55.9%*	31.4%
-C-: Shopping	54%		-	50.3%**	35.6%***
-III- Which of the following percentages is the biggest: One percent, ten percent or five percent?					
-A-: Math	91%	21.9%	4.8%**	57.1%	52.8%**
-B-: Medicine	69%	-	17.1%	56.6%	22.2%**
-C-: Shopping	86%		-	45.7%**	65.6%
-IV- Which is the most: 1 in 100, 1 in 1,000 or 1 in 10?					
-A-: Math	73%	2.3%**	12.8%	52.5%*	30.9%**
-B-: Medicine	75%	-	15.1%	82.3%	50.0%
-C-: Shopping	60%		-	74.6%	80.5%

Notes: In the "Comparability" column the asterisks denote statistically significant differences in the percent of respondents answering the question correctly in two given contexts (i.e., A vs. B). The p-values are displayed in the column and row corresponding to the two question contexts tested. In the Assets column the asterisks denote whether the ratio of assets for those who answer incorrectly versus those who answer correctly is significantly different from one (i.e., the assets of both groups are equal). Statistical significance is estimated by a t-test with p-values denoted $*p < .10$; $**p < .05$; $***p < .01$.

As Table 2 documents, context appears to matter in terms of the percent of respondents who answer a given question correctly. For example, take three closely related questions asked in the 2002 HRS numeracy module:

> *-A- "What is 15 percent of 1,000?"*
> *-B- "A pill cures 15 percent of people who have a disease. If 1,000 people have the disease and they all take the pill, how many people will be cured?"*
> *-C- "A store is offering a 15% off sale on all TVs. The most popular television is normally priced at $1,000. How much money would a customer save on the television during this sale?"*

All three variants of this question test whether the respondent can identify that 15% of 1,000 is equal to 150. Rates of correct response

across the questions, as reported in Table 2, reveal differences based on context. Only 70% of those responding to -*C*-, what we term the "shopping" context, correctly answer "150" versus 82% asked the pure math version -*A*-. Variant -*B*-, what we term the "medical" context, yields the lowest rate of correct response 62%. A *t*-test comparing variants -*A*- and -*B*- rejects the null that they are equally difficult, the null of equivalence for -*A*- and -*C*- is also rejected. However, the response rates to contexts -*B*- and -*C*- are not statistically different.

Regardless of the version of the question asked, whether the respondent is correct or incorrect appears related to asset levels and asset growth between the years 1992 and 2008. Overall, those that respond incorrectly have asset balances across all waves of the HRS that are on average only 30% as large as those who answer the questions correctly. Moreover their assets grow at a lower rate over the sample period. Version B of the question, the medical context, does the best job of distinguishing change in assets. Notably those that answer version B incorrectly grow their assets by only 3% as much as those who get it correct over the period of study. This difference is statistically significant at the 1% level.

A second question examining the respondent's mathematical aptitude asks whether they can identify that 10 is 1% of 1,000 in a variety of contexts. This question appears to be harder than the first question, as a lower percentage of respondents get it correct, regardless of the context. The purely numerical context for the question, -*A*-, yields a 45% correct response rate, while the shopping context, -*C*-, yields a 54% success rate. Once again the medical context has the lowest percent of correct responses, with a 28% success rate. Comparing the correct response rates to the various versions of the question, we find that the percent correctly answering -*B*- is statistically different from the other two versions, but there is no significant difference between the response rates to -*A*- and -*C*-.

The questions in Table 2 vary significantly in level of difficulty as measured by the rate of correct response. Moreover, the extent of their correlation with financial outcomes varies. On average, those respondents who get the questions incorrect hold much lower levels of wealth in each wave of the HRS than those who correctly answer the questions. Questions that are moderately difficult appear to do a better job of separating respondents in terms of their future change in asset values, as compared to those questions that are relatively hard or easy. What is more, answering incorrectly is consistently correlated with a respondent having a lower value of assets.

Consistency of Responses to Financial Literacy Questions Across HRS Waves

As shown previously in Table 1, HRS respondents have been asked the three financial literacy questions first introduced in the 2004 wave from one to three times. This repetition allows us to consider the consistency with which people respond to the questions and whether the respondents improve their financial knowledge following the initial response, as suggested by Mandell and Klein (2007). Table 3 presents evidence on the repetition of an easy, medium, and hard financial literacy question—as evidenced by rates of success the first time the respondent answers the question. The easy question focuses on calculating a percent:

> *If the chance of getting a disease is 10 percent, how many people out of 1,000 would be expected to get the disease?*

In 2004, 83% of respondents correctly answered the question. Some of these correct responses are rather tenuous, as 58% of respondents who answer this question incorrectly in 2006 get it right in 2004. Of those that get the question wrong the first time, 59% respond correctly in 2006. Given that both the sample sizes and percentages of those who move from correct to incorrect or vice versa are similar, it is unsurprising that the rate of success conditional on being asked a second time is 84%, basically unchanged. It appears that some guessing is being measured along with actual understanding of the question.

Concentrating only on those who get the answer right, conditional on being correct in 2004, 89% are again correct in 2006. Conditional on having been correct in both the 2004 and 2006 waves of the HRS, success increases to 90%. However, this still leaves 10% of respondents at each wave who would appear to be financially literate based on 2004 and 2006 responses, but are subsequently measured to be financially illiterate, demonstrating the limitations of a cross-sectional measure of financial literacy.

The second question presented in Table 3 tests a respondent's ability to perform division:

> *If 5 people all have the winning numbers in the lottery and the prize is $2 million, how much will each of them get?*

Only 57% of respondents got this question right in 2004. Of those who got the question right in 2004, 72% get the question right when asked again in 2006. Among those who got the question wrong in 2004, 46% get it right in 2006. This suggests that between the two waves they either learned the correct answer, or that they guessed in one or more

TABLE 3
Evidence on Consistency in Responses Across Waves

	N	Correct	SD	
Chance of getting a disease (10% of 1,000 [100])				
(2004)	3,201	83%	38%	Overall
	2,251	89%	31%	If correct in future (2006)
	421	58%	49%	If incorrect in future (2006)
(2006)	15,808	77%	42%	Overall
	2,672	84%	36%	If second time asked
	2,249	89%	31%	If previously correct (2004)
	423	59%	49%	If previously incorrect (2004)
(2008)	117	84%	37%	Overall
	44	80%	41%	If never before asked
	36	89%	32%	If third time asked
	2	50%	71%	If previously always incorrect
	65	88%	33%	If ever correct in past
	31	90%	30%	If always correct in past
Lottery winnings split five ways (20% of $2 million [$400,000])				
(2004)	2,932	57%	49%	Overall
	1,396	71%	45%	If correct in future (2006)
	851	45%	50%	If incorrect in future (2006)
(2006)	13,665	53%	50%	Overall
	2,247	62%	49%	If second time asked
	1,375	72%	45%	If previously correct (2004)
	872	46%	50%	If previously incorrect (2004)
(2008)	100	47%	50%	Overall
	41	37%	49%	If never before asked
	30	60%	50%	If third time asked
	2	50%	71%	If previously always incorrect
	45	53%	50%	If ever correct in past
	17	71%	47%	If always correct in past
Interest on savings ($200 compounded at 110% annually for 2 years [$242])				
(2004)	2,778	14%	35%	Overall
	363	44%	50%	If correct in future (2006)
	1,710	11%	31%	If incorrect in future (2006)
(2006)	12,082	12%	33%	Overall
	2,073	18%	38%	If second time asked
	344	46%	50%	If previously correct (2004)
	1,729	12%	32%	If previously incorrect (2004)
(2008)	98	8%	28%	Overall
	42	2%	15%	If never before asked
	29	14%	35%	If third time asked
	19	21%	42%	If previously always incorrect
	12	0%	0%	If ever correct in past
	2	0%	0%	If always correct in past

waves. Of those respondents who answered the question correctly in both 2004 and 2006, 71% correctly answer the question again in 2008. Given the increased difficulty of this question relative to the first question, the percentage of respondents who are guessing at the answer appears to be much higher, as demonstrated by the much lower rate of repeat correct responses.

The last question presented in Table 3 asks respondents about compound interest:

> *Let's say you have $200 in a savings account. The account earns 10 percent interest per year. How much would you have in the account at the end of two years?*

This appears to be the hardest of the questions as only 14% get it right in 2004. Moreover, even among those who responded correctly in 2004, only 46% answer correctly when asked again in 2006. Of those who answered incorrectly in 2004, only 12% subsequently get the question right when asked in again 2006. The small change in incorrect to correct responses across waves for this question suggests there is little learning occurring between waves, but also argues against guessing, which would have resulted in more people answering correctly in 2006.

The differences in net worth of those who correctly respond to the financial literacy questions relative to those who do not, as well as the inconsistency in question responses, suggests that whether individuals consistently respond correctly to the questions across waves may be a better predictor of financial well-being.

EMPIRICAL ANALYSIS

While the correlations we have discussed above provide some evidence that correctly responding to certain financial literacy questions is indicative of improved financial outcomes, a regression framework allows us to control for a host of characteristics that may be related to both correctly responding to these financial literacy questions and financial well-being. We run an OLS regression to examine the relationship between financial outcomes and the three financial literacy questions asked in the 2002, 2004, and 2006 HRS surveys. As documented earlier, the number of respondents who are asked each question in 2004 is comparatively smaller than 2002 and 2006, so we focus on the 2002 and 2006 responses. Using the respondent's answers to these questions, we try to determine if consistently answering correctly is positively correlated with better financial outcomes in the future, holding other factors constant. For our dependent variable, we calculate the percentage change

in non-housing assets between 2002 and 2006 as well as 2002 and 2008 as a proxy for financial outcomes.

Our model for these changes in wealth takes the form:

$$\Delta W_i = \alpha + \beta X_i + \gamma FinLit_i + \epsilon_i \tag{1}$$

where ΔW alternately represents the percentage change in non-housing wealth from 2002 to 2006 or 2002 to 2008. X is a vector of demographics including indictor variables for race, gender, highest level of education attained, having a defined benefit pension plan, and currently receiving Social Security Disability Insurance (SSDI). In our first specification, the variable *FinLit* includes a simple count of the number of questions answered correctly across all three questions and waves, with possible values ranging from 0 (no questions correct in any wave) to 6 (all questions correct in both waves), as well as a quadratic for the number of questions correct to capture any potential non-linearity in the relationship. In our second set of specifications *FinLit* includes indicators for whether the respondent correctly answered each of the three financial literacy questions once (in the 2002 wave or the 2006 wave) or twice (in both the 2002 and 2006 waves). Incorrectly answering the question in both waves is used as the reference (omitted) category. Lastly, ϵ is an error term, and i indexes individuals. Table 4 provides summary statistics on each dependent variable, financial literacy variable, and control variable for the sample of individuals who have complete observations for every variable.

The regressions presented in Table 5 estimate the relationship between the responses to the financial literacy questions and the percent change in non-housing wealth between 2002 and 2006. All model specifications include the full set of demographic variables. The first column estimates the effect of the number of financial literacy questions answered correctly on the change in wealth. The coefficient on the score variable suggests that for every additional question answered correctly the change in assets declined by 15 percentage points. However, this is marginally offset by the coefficient suggesting a 2 percentage point increase for score squared. Thus these coefficients imply that a person answering all six questions correctly would have a 23 percentage point lower change in assets than someone who got all questions wrong.

In rows 2 through 6 of Table 5, the effect of correctly answering each individual question on assets independently is examined. In column 2 the coefficients are in the expected direction, as answering the interest question correctly once is estimated to add 15 percentage points to the change in wealth, while answering it correctly twice adds 32 percentage

TABLE 4
Summary Statistics for Variables Employed in Regression Analysis

	Wealth Change Sample		2008 Wealth Sample	
	Mean	SD	Mean	SD
Dependent variables				
Change in non-housing assets: 2002–2006	0.754	2.195		
Change in non-housing assets: 2002–2008	0.741	2.258		
Log non-housing assets in 2008			11.92	1.866
Independent variables				
Less than high school	0.067	0.250	0.066	0.248
High school	0.379	0.485	0.382	0.486
Some college	0.255	0.436	0.257	0.437
College	0.299	0.458	0.295	0.456
Least risk averse	0.112	0.315	0.112	0.316
Third most risk averse	0.104	0.305	0.103	0.304
Second most risk averse	0.133	0.340	0.135	0.342
Most risk averse	0.651	0.477	0.650	0.477
White	0.909	0.288	0.905	0.294
Hispanic	0.026	0.159	0.029	0.166
Black	0.044	0.206	0.046	0.209
Other race	0.021	0.143	0.021	0.144
Female	0.545	0.498	0.547	0.498
Defined benefit pension	0.631	0.483	0.630	0.483
Ever applied for SSI/SSDI	0.078	0.268	0.081	0.274
One interest question correct	0.171	0.377	0.169	0.375
Both interest questions correct	0.057	0.232	0.056	0.230
One disease question correct	0.098	0.297	0.097	0.296
Both disease questions correct	0.893	0.310	0.893	0.309
One lottery question correct	0.341	0.474	0.344	0.475
Both lottery questions correct	0.502	0.500	0.501	0.500
Number of questions answered correctly	3.51	1.053	3.511	1.046
N	1,155			1,228

Note: Summary stats for regression sample with all financial literacy questions included.

points to the change in wealth relative to someone who responds incorrectly twice. In column 3, the relationship between the disease question and the change in wealth is less consistent. Correctly answering the questions once *reduces* the change in wealth by 6 percentage points relative to answering incorrectly. However, correctly answering it twice increases the change in wealth by 9 percentage points relative to answering incorrectly twice. In column 4 the relationship is again inconsistent, with answering correctly once now increasing the change in wealth by 11 percentage points and answering correctly twice *decreasing* the change in wealth by 15 percentage points. Lastly, in column 5 we include the responses to all three questions in the regression. As found

TABLE 5
Determinants of Change in Non-Housing Wealth 2002–2006

Change in non-housing wealth from 2002 to 2006	1	2	3	4	5
Measures of performance					
Number of questions answered correctly	−0.158				
scaled (0, . . . , 6)	(−0.429)				
Number of questions answered correctly squared	0.020				
scaled (0, . . . , 36)	(0.405)				
Interest question correct - once only		0.150			0.200
binary (0, 1)		(0.850)			(1.085)
Interest question correct - twice		0.315			0.462
binary (0, 1)		(1.089)			(1.552)
Disease question correct - once only			−0.061		−0.191
binary (0, 1)			(−0.319)		(−0.269)
Disease question correct - twice			0.089		−0.058
binary (0, 1)			(0.497)		(−0.084)
Lottery question correct - once only				0.112	0.012
binary (0, 1)				(0.725)	(0.061)
Lottery question correct - twice				−0.150	−0.295
binary (0, 1)				(−0.968)	(−1.489)
Education					
High school	0.069	−0.012	−0.018	−0.132	0.075
binary (0, 1)	(0.259)	(−0.054)	(−0.113)	(−0.655)	(0.280)
Some college	0.275	0.166	0.065	0.057	0.280
binary (0, 1)	(0.985)	(0.689)	(0.359)	(0.260)	(1.002)
College	0.138	0.027	−0.031	0.003	0.138
binary (0, 1)	(0.489)	(0.111)	(−0.169)	(0.012)	(0.491)
Risk preference					
Least risk averse	0.224	0.253	0.237	0.214	0.205
binary (0, 1)	(1.057)	(1.289)	(1.451)	(1.165)	(0.966)
Third most risk averse	−0.040	−0.063	−0.037	−0.113	0.001
binary (0, 1)	(−0.181)	(−0.307)	(−0.216)	(−0.579)	(0.004)
Second most risk averse	−0.182	−0.053	−0.098	−0.244	−0.177
binary (0, 1)	(−0.938)	(−0.294)	(−0.617)	(−1.388)	(−0.909)
Other characteristics					
Hispanic	−0.656	−0.334	0.178	−0.494	−0.642
binary (0, 1)	(−1.550)	(−0.933)	(0.706)	(−1.544)	(−1.519)
Black	0.162	0.090	0.027	0.152	0.196
binary (0, 1)	(0.528)	(0.321)	(0.139)	(0.648)	(0.637)
Other race	0.120	0.038	0.216	−0.115	0.164
binary (0, 1)	(0.267)	(0.088)	(0.595)	(−0.296)	(0.365)
Female	0.058	0.049	0.046	0.054	0.065
binary (0, 1)	(0.434)	(0.396)	(0.426)	(0.453)	(0.489)
Defined Benefit Pension	0.099	0.186	0.180*	0.091	0.081
binary (0, 1)	(0.717)	(1.449)	(1.665)	(0.748)	(0.589)
Ever applied for SSI/SSDI	0.178	0.234	0.010	0.126	0.180
binary (0, 1)	(0.750)	(1.083)	(0.061)	(0.634)	(0.759)
Constant	0.828	0.520**	0.546**	0.747***	0.693
	(1.215)	(2.279)	(2.561)	(3.468)	(0.932)
Observations	1,278	1,487	2,107	1,613	1,278

Note: t statistics in parentheses.
*$p < .10$; **$p < .05$; ***$p < .01$.

in the previous specifications, the relationship between correct answers to the questions and changes in assets only operates in the expected direction for the interest question. Across all specifications presented in Table 5, none of the relationships between responses to the financial literacy questions and the change in assets is statistically significant.

Table 6 presents the regression results from the same set of specifications as in Table 5 for the dependent variable change in non-housing wealth from 2002 to 2008. In column 1, the coefficient magnitudes are similar to those found in Table 5 with an additional question correct decreasing the change in wealth by 17 percentage points, while the coefficient on square of the number of questions correct suggests a partially offsetting increase in change in wealth of 2 percentage points. In column 2 we observe that responding correctly once to the question on interest has a statistically significant effect on one's change in wealth, increasing it by 41 percentage points. However, getting the questions correct in both waves has no effect on wealth. Again, the disease and lottery questions have no significant relationship with the change in wealth, nor do the coefficients have the expected magnitudes and directions. When all questions are pooled in column 5, correctly responding to the interest question remains a significant predictor of the change in wealth. Moreover, the coefficient's magnitude is relatively stable, now reported as resulting in a 39 percentage point increase for answering correctly once. Answering the interest question correctly twice increases the change in wealth by 4 percentage points; although it is not significant. For both the disease and lottery questions the coefficients are inconsistent in magnitude and direction with their expected effect on the change in wealth.

Overall, we find little relationship between correctly responding to these particular questions and changes in wealth from 2002 to 2006 or 2002 to 2008 after controlling for demographic characteristics. Moreover, consistently getting the questions correct across waves appears to have only a weak relationship to the changes in wealth. Of all variables studied, only the compound interest question demonstrated stable positive relationship at the 95% confidence level or higher.

In order to examine whether responses to the financial literacy questions are correlated with point-in-time wealth, as has been found in previous studies, we re-estimate model (1) with the log of 2008 non-housing wealth as the dependent variable. As shown in Table 7, correctly responding to any of the financial literacy questions appears to be positively and significantly related to non-housing wealth in 2008. Moreover, the magnitudes of the coefficients on the indicators for answering a question correctly in only one wave are consistently

TABLE 6
Determinants of Change in Non-Housing Wealth 2002–2008

Change in non-housing wealth from 2002 to 2008	1	2	3	4	5
Measures of performance					
Number of questions answered correctly	−0.166				
scaled (0, . . . , 6)	(−0.418)				
Number of questions answered correctly squared	0.018				
scaled (0, . . . , 36)	(0.331)				
Interest question correct - once only		0.405**			0.389**
binary (0, 1)		(2.194)			(1.975)
Interest question correct - twice		−0.003			0.036
binary (0, 1)		(−0.009)			(0.113)
Disease question correct - once only			−0.256		−1.366*
binary (0, 1)			(−1.173)		(−1.840)
Disease question correct - twice			−0.102		−1.169
binary (0, 1)			(−0.496)		(−1.635)
Lottery question correct - once only				−0.039	−0.232
binary (0, 1)				(−0.222)	(−1.061)
Lottery question correct - twice				−0.188	−0.385*
binary (0, 1)				(−1.058)	(−1.775)
Education					
High school	0.059	−0.058	0.101	−0.028	0.042
binary (0, 1)	(0.196)	(−0.233)	(0.558)	(−0.119)	(0.141)
Some college	0.267	0.105	0.231	0.143	0.261
binary (0, 1)	(0.846)	(0.400)	(1.125)	(0.561)	(0.828)
College	0.185	0.021	0.209	0.138	0.171
binary (0, 1)	(0.580)	(0.080)	(0.982)	(0.531)	(0.537)
Risk preference					
Least risk averse	−0.077	−0.109	−0.025	0.046	−0.103
binary (0, 1)	(−0.336)	(−0.524)	(−0.136)	(0.218)	(−0.445)
Third most risk averse	−0.173	−0.102	−0.243	−0.207	−0.149
binary (0, 1)	(−0.723)	(−0.464)	(−1.241)	(−0.922)	(−0.621)
Second most risk averse	−0.241	−0.140	−0.153	−0.170	−0.223
binary (0, 1)	(−1.126)	(−0.722)	(−0.839)	(−0.835)	(−1.043)
Other characteristics					
Hispanic	−0.741*	−0.646*	−0.485*	−0.530	−0.779*
binary (0, 1)	(−1.671)	(−1.809)	(−1.811)	(−1.548)	(−1.759)
Black	−0.300	−0.142	0.149	−0.094	−0.279
binary (0, 1)	(−0.867)	(−0.448)	(0.666)	(−0.343)	(−0.806)
Other race	0.347	0.315	0.325	0.074	0.374
binary (0, 1)	(0.684)	(0.657)	(0.776)	(0.162)	(0.737)
Female	−0.036	−0.015	0.122	0.117	0.006
binary (0, 1)	(−0.252)	(−0.111)	(1.002)	(0.867)	(0.038)
Defined Benefit Pension	0.161	0.063	0.044	0.149	0.146
binary (0, 1)	(1.073)	(0.467)	(0.357)	(1.075)	(0.979)
Ever applied for SSI/SSDI	0.114	0.167	0.251	0.306	0.147
binary (0, 1)	(0.430)	(0.708)	(1.310)	(1.327)	(0.553)
Constant	1.003	0.733***	0.709***	0.718***	2.029***
	(1.344)	(2.943)	(2.927)	(2.848)	(2.591)
Observations	1,186	1,383	1,960	1,505	1,186

Note: t statistics in parentheses.
*$p < .10$; **$p < .05$; ***$p < .01$.

TABLE 7
Determinants of Non-Housing Wealth in 2008

Ln (non-housing wealth in 2008)	1	2	3	4	5
Measures of performance					
Number of questions answered correctly	−0.077				
scaled (0, . . . , 6)	(−0.276)				
Number of questions answered correctly squared	0.033				
scaled (0, . . . , 36)	(0.888)				
Interest question correct - once only		0.367***			0.298**
binary (0, 1)		(2.813)			(2.168)
Interest question correct - twice		0.469**			0.351
binary (0, 1)		(2.213)			(1.595)
Disease question correct - once only			0.336**		0.158
binary (0, 1)			(2.278)		(0.300)
Disease question correct - twice			0.577***		0.300
binary (0, 1)			(4.188)		(0.592)
Lottery question correct - once only				0.212*	0.092
binary (0, 1)				(1.784)	(0.600)
Lottery question correct - twice				0.422***	0.241
binary (0, 1)				(3.541)	(1.585)
Education					
High school	0.660***	0.582***	0.874***	0.853***	0.653***
binary (0, 1)	(3.102)	(3.290)	(7.073)	(5.385)	(3.064)
Some college	0.894***	0.834***	1.190***	1.126***	0.882***
binary (0, 1)	(4.040)	(4.491)	(8.599)	(6.545)	(3.976)
College	1.601***	1.563***	1.875***	1.865***	1.592***
binary (0, 1)	(7.140)	(8.294)	(13.048)	(10.648)	(7.089)
Risk preference					
Least risk averse	−0.099	−0.175	−0.214*	−0.099	−0.104
binary (0, 1)	(−0.626)	(−1.197)	(−1.735)	(−0.714)	(−0.654)
Third most risk averse	−0.241	−0.161	−0.078	−0.289*	−0.249
binary (0, 1)	(−1.455)	(−1.043)	(−0.591)	(−1.933)	(−1.498)
Second most risk averse	−0.011	0.049	0.004	−0.038	−0.006
binary (0, 1)	(−0.075)	(0.364)	(0.036)	(−0.287)	(−0.042)
Other characteristics					
Hispanic	−1.440***	−1.590***	−1.537***	−1.623***	−1.441***
binary (0, 1)	(−4.807)	(−6.270)	(−8.296)	(−7.085)	(−4.801)
Black	−1.167***	−1.280***	−1.339***	−1.151***	−1.158***
binary (0, 1)	(−4.902)	(−5.901)	(−8.967)	(−6.327)	(−4.848)
Other race	−0.193	−0.145	−0.275	−0.417	−0.196
binary (0, 1)	(−0.563)	(−0.438)	(−0.995)	(−1.385)	(−0.569)
Female	0.059	0.053	0.116	0.064	0.066
binary (0, 1)	(0.595)	(0.571)	(1.413)	(0.713)	(0.656)
Defined Benefit Pension	0.062	0.064	0.104	0.104	0.058
binary (0, 1)	(0.595)	(0.672)	(1.270)	(1.125)	(0.557)
Ever applied for SSI/SSDI	−0.891***	−0.761***	−0.898***	−0.838***	−0.886***
binary (0, 1)	(−4.843)	(−4.609)	(−6.915)	(−5.443)	(−4.807)
Constant	10.924***	11.062***	10.229***	10.526***	10.599***
	(21.074)	(62.457)	(63.252)	(61.750)	(19.204)
Observations	1227	1428	2015	1546	1227

Note: t statistics in parentheses.
*$p < .10$; **$p < .05$; ***$p < .01$.

lower than for the coefficients on the indictor for answering the question correctly in both waves. For example, in column 2, individuals who correctly answer the interest rates question once are predicted to have 37% more non-housing wealth in 2008 than those who answer incorrectly, while those who answer correctly twice are predicted to have 47% more wealth than those who answer incorrectly. Similar results are found for the disease question in column 3 and the lottery question in column 4. Even in column 5, where all three questions are included in the regression, the coefficients consistently show a positive relationship between responding correctly and wealth, and that responding correctly twice is correlated with higher wealth than responding correctly only once. However, in this final specification only one coefficient remains statistically significant.

CONCLUSIONS

Herein, we have detailed the relationship between responses to a variety of widely used financial literacy questions and respondents' financial well-being. We have documented inconsistencies in how people respond to these questions based on the context of the question at a point in time. We further documented inconsistencies in how respondents answer the same financial literacy question across waves of the HRS. The small number of respondents who correctly answer the questions in multiple waves of the HRS relative to the number who respond correctly in a cross-section suggests that panel data yields much more complete information on the respondent's financial knowledge than can be obtained from cross-sectional data alone. Responding correctly to difficult personal finance questions at any point in time provides some evidence of financial capacity, but it does not consistently guarantee positive financial outcomes.

Our regression results suggest little relationship between correctly responding to the disease question or lottery question and subsequent changes in wealth. Moreover, even consistently getting these questions correct has no significant or positive effect on wealth. While the coefficients on the interest question at least have the correct sign, only in Table 4 does answering the question correctly twice result in a better financial outcome than answering correctly only once.

Overall, it appears that panel measures of financial literacy grant some additional insight into the difference between financial knowledge and financial outcomes. If the goal of financial literacy measures is to simply document financial capacity in the broadest sense, then repeating

cross-sectional measures with validated questions and measures may be sufficient. However, if what really matters is long-term individual financial well-being, then our findings suggest that longitudinal data, where the consistency of individual responses to financial literacy questions can be assessed, may yield more accurate results.

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