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Financial Literacy in the US: A Robustness Check of the Lusardi-Mitchell Questions*

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A B S T R A C T

This study tested the reliability of financial literacy measures used in previous studies based on a set of items referred to as the "Lusardi-Mitchell questions". Using a sample of 514 American adults that completed a questionnaire with fifty financial literacy items, the authors compared (1) the results from a set of multivariate regression analyses that used the Lusardi-Mitchell questions to investigate the explanatory power of financial literacy on different financial behaviors, with (2) results that used alternative financial literacy measures that differ by the topic of the items or the number of the items. Doing so the paper investigate the chance that a scale based on a small number of items could not provide a precise measure of people financial literacy, due to a lack of information. Results suggest that the Lusardi-Mitchell questions provide a measure of financial literacy that is close to the results obtained using more sophisticated measures. In addition, the results supported the hypothesis that the financial literacy positively affects different financial behaviors.

Keywords: Financial Literacy, Lusardi-Mitchell, Financial Education

Ⅰ. Introduction

Several studies on financial literacy published in the

last 15 years, and the development of national strategies to improve financial literacy in a growing number of countries, are evidence of the interest that financial literacy receives from both researchers and policy makers (Huston 2010, Atkinson and Messy 2012, OECD 2017, OECD 2020). The question whether a higher level of financial literacy is associated with improved financial decisions is the main hypothesis that supports this research interest. The validity of this assumption is pivotal for the promoter of financial education curricula too. The purpose of any financial education initiative is to increase the financial literacy of individuals and is motivated by the assumption that increasing financial literacy can improve the financial behaviors of individuals. This general assumption is present in studies that address quite different financial behaviors, including borrowing decisions, investment decisions, retirement planning, saving, money management, and other financial issues. Most of the cases rely on measures

of financial literacy based on a few items that address basic financial principles like inflation, or compound interest (Hira and Loibl 2005; Atkinson and Kempson 2008; Lusardi and Tufano 2009; Lusardi and Mitchell 2011; Brown and Graf 2013). This happens quite frequently with the use of public data, where financial literacy items are added from previous waves of the same survey. The risk in assessing financial literacy by a few items based on basic financial principles can be to highlight those who struggle the most in dealing with financial issues and that are not able to correctly answer even a simple question. This type of measure will not highlight differences between other groups which could differ a lot in terms of knowledge, skills, and attitudes. The weakness of a limited financial literacy measure could be the reason some studies on financial literacy have not found a correlation with financial behaviors or explained only a small role of financial literacy in the decision-making processes of households. This may be because the assessment of financial literacy failed to properly measure the construct, while the availability of more items may find a correlation between financial literacy and financial behaviors (Nicolini, 2019a, 2019b).

These issues are important to consider, because the presence of a correlation between financial literacy and financial behaviors may not create a strong enough argument to promote and invest in financial education. If financial literacy is correlated with the quality of financial decisions, then researchers need to carefully examine the magnitude of that correlation and consider the chance that other variables could be more relevant than financial literacy. From a more technical point of view, this means that a variable used to assess financial literacy could be statistically significant, but not determinant, in explaining financial behaviors (e.g., value of a coefficient close to zero, odds close to one, etc.), or the marginal effect of financial literacy could be overwhelmed by other factors (e.g. other variables perhaps more relevant than financial literacy). In both cases, the perceived risk of investing in financial literacy may not be rewarded with the anticipated outcome. The development of different measures of financial literacy can help to understand, in more detail, the correlation between financial literacy and financial behaviors (Ranyard et al. 2019, Houts and Knoll 2020). A different measure of financial literacy can show a correlation when it was not found before, or it can show a bigger correlation where financial literacy was a statistically significant variable,

but it was not a key variable.

This study aimed to compare financial literacy measures widely used in previous studies - based on a few items and usually referred as the "Lusardi-Mitchell questions" - with different financial literacy measures developed from a broader set of items. In that manner, we can test if the small number of items is a limitation or not, and we can check possible alternative set of items and their explanatory power of an individual's financial literacy. Testing these financial literacy measures on several financial behaviors we can even test how much financial literacy improves financial behaviors referring to different financial decisions contexts.

Ⅱ. Literature Review

The hypothesis that financial literacy can help explain financial behaviors and that an improvement in financial literacy can improve the quality of financial decisions of individuals has been tested in several studies. For instance, Moore (2003) analyzed how financial literacy affects the use of payday loans and the cash advance on credit cards, using a sample of over 1,400 residents in Washington State. The study found that lower financial literacy was associated with an increased attitude to use payday loans and to withdraw cash on credit cards. Robb (2011) used the information from a sample of American college students (1,354 obs.), collected in 2007, to examine how well financial literacy explains the use of credit cards by college students. Results suggest that students with higher scores on a measure of financial literacy were more likely to engage in more responsible credit card use. The relationship between financial literacy and the use of credit cards in the US has been studied also by Allgood and Walstad (2011) where the authors used the 2009 NFCS (National Financial Capability Study). Results from the analysis, based on the self-perception of financial literacy of the more than 28,000 American adults, showed that financial literacy helps to explain the use of credit cards. Mottola (2013) used the same database (NFCS 2009) looking at the same financial behaviors for credit cards, using objective measures of financial literacy. Results supported the hypothesis that a lack of financial literacy is positively related to costly credit card

behaviors. Evidence of the explanatory power of financial literacy on the use of credit has been found also by Disney and Gatherhood (2013) and by Lusardi and Tufano (2009). The first authors analyzed a sample of 3,041 residents in the UK and concluded that financial literacy is on average lower among those who participate in the consumer credit markets, compared with those who do not. Lusardi and Tufano analyzed the role of financial literacy on over-indebtedness and the use of high-cost borrowing vehicles in the US (e.g., auto title loans, student loans, payday loans, etc.). Once again, the results supported the hypothesis that a connection between financial literacy and financial behaviors exists. In their conclusions, the authors stress "*as much as one-third of the charges and fees paid by less knowledgeable individuals can be attributed to ignorance*". Meanwhile, a low level of financial literacy increases the chance that people feel they carry too much debt. Regarding borrowing and over-indebtedness, Gerardi et al. (2010) studied a sample of American borrowers in 2008 and found a strong association between (low) financial literacy and mortgage delinquency. More recently, Clark et al. (2021) have found that people with high financial literacy were more able to deal with the shocks due to the Covid-19 pandemic, and Klapper and Lusardi (2019) have found how relatively low financial literacy levels exacerbate consumer and financial market risks as increasingly complex financial instruments enter the market.

A. Financial Literacy and Saving and Investment Behaviors

Other studies have analyzed the connection between financial literacy and saving and investment behaviors. Kimball and Shymway (2007) analyzed data from a sample of 500 American adults and found that financial literacy is related to stock market participation. Those who are more financially literate seem to be, not only more prone to invest in stocks, but also more likely to invest in international assets, and to hold a diversified portfolio. Yoong (2011) studied the relationship between stock market participation and financial literacy as well. Using a sample of 533 American adults (40+ years old) from the 2007 American Life Panel (ALP survey), the author highlighted how ignorance about stock market investments significantly reduced the propensity to hold stocks. Specifically, a

decrease of one standard deviation above the mean level of financial literacy resulted in a decrease in stock market participation of 10%. The positive role of financial literacy on stock market participation was confirmed also by Almenberg and Dreber (2015) - in a study with data from Sweden - and by Van Rooij et al. (2011) - in a study on stock market participation in the Netherlands. Van Rooij et al. found that the lack of financial literacy was statistically relevant in explaining the lack of stock market participation. Regarding financial literacy and investment decisions, Muller and Weber (2010) used a sample of 3,228 German adults to test the hypothesis that, between investors, the more financially literate tend to rely more on passive mutual funds than low literate people. Results confirmed once more the correlation between financial literacy and financial behaviors. In addition, Arrondel et al. (2012) have shown - using data from France - how financial literacy positively affects the propensity to plan. Similar results were found in other financial contexts like the presence or not of emergency funds (Robb and Woodyard 2011), and homeownership (Almenberg and Widmark 2011). Liao et al. (2018), using data from the 2014 China Survey of Consumer Finances, examine the relation between financial literacy and the risky asset holding behaviour of Chinese households, and their findings reveal that consumers with higher levels of financial literacy are more likely to hold risky financial assets than those with lower levels.

B. Financial Literacy and Retirement Planning

Other studies investigated the connection between financial literacy and financial behaviors in retirement planning. Gustman et al. (2012) studied the retirement preparedness of Americans by analyzing data from the 2004 Health and Retirement Survey (HRS). Song (2020) studied retirement planning in China using a sample of 1,153 Chinese adults linking the contribution to retirement savings plans (in local currency) with two measures of financial literacy. Klapper et al. (2013) used a sample of over 1,400 Russian individuals to test how financial literacy is related to the decision to invest in privately or publicly owned retirement funds. Honekamp (2012) studied the correlation between financial literacy and investment in supplemental pension insurance in Germany, while Brown and Graf (2013) did a similar study in Switzerland. All

these studies support the hypothesis that financial literacy helps individuals make better financial decisions.

C. Measuring Financial Literacy

In a recent study on the assessment of financial literacy, Nicolini (2019) reviewed more than 80 studies and found that the majority of the cases rely on financial literacy measures developed from a small set of items that addressed basic financial concepts. A set of three items developed by Lusardi and Mitchell in 2004[1] - the "Lusardi-Mitchell questions" - addressed basic economic principles such as inflation, compound interest, and the diversification in the stock market. The three items were easy to add to pre-existing surveys and the basic knowledge addressed by those items made them an ideal measure to examine financial literacy and to study its correlation with financial behaviors. A few years later, two more items were added to the "big three" questions in the National Financial Capability Study (FINRA 2012), dealing with the functioning of mortgages, and bond pricing. This set of five items has been widely used in further studies and added to several surveys, becoming a sort of "gold standard" in the assessment of financial literacy. The so-called Lusardi-Mitchell questions proved to be a quite effective measure of financial literacy, especially keeping in mind that (1) they are just five items, (2) they address basic concepts, and (3) they refer to different areas of knowledge (e.g., mortgage, bond, stock, etc.). An overview of financial literacy requires addressing basic concepts and referring to different areas of knowledge, but the same items could be less appropriate to study specific financial behaviors, as the use of credit cards, or the decision to default on a mortgage. Some items may be more associated with certain financial decisions than others. For instance, the decision to default on a mortgage may be related to the knowledge about how mortgages work but may be less correlated with knowledge about bond pricing. The use of credit cards can be explained by knowledge about interest rates more than knowledge about mortgages, and investment decisions are logically related to items that address bond pricing and the stock market more than mortgages. Also,

the five items do not provide the flexibility to address the same topic using more than one item, therefore, reducing the opportunity to assess whether an individual knows only basic concepts or if the individual has advanced knowledge. The opportunity to include many items in large surveys is not always feasible and the use of items on fundamental principles should be preferred to the use of items on a single topic to guarantee the availability of at least one item related to a certain financial behavior[2]. However, the curiosity to understand the results that could have been found if more items - addressing different topics, and testing different levels of knowledge - remains, and it is one of the aims of this study.

An ideal survey would include a balanced number of items. When more items are available it is possible to analyze not only knowledge of basic principles but also knowledge of more advanced concepts. It is also helpful to test different levels of knowledge. Moreover, the assessment of financial literacy could be extended beyond knowledge to include an assessment of skills and attitudes (Huston 2010, Remund 2010, Atkinson and Messy 2012). However, assessing financial literacy more precisely may not require adding several items to increase the assessment from basic to more sophisticated. To assess the reliability of the widely used measures of financial literacy, we first focused on the assessment of financial knowledge and its relationship to financial behaviors.

The aim of this study was to examine how financial literacy results change when assessing it using different measures of financial literacy based on more than a few items. In particular, this study used data from a new survey to compare measures of financial literacy used in previous studies with other measures made possible by adding items on specific areas of knowledge and using more than one item for the same area of knowledge.

III. Data and Methodology

This study is based on data collected by a specific survey administered in 2020 on a sample of 514 American

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[1] The questions were added to the 2004 Health and Retirement Study and used for the first time in a research output in 2006 (see Lusardi and Mitchell 2006).

[2] The item on the knowledge of mortgage can be useful to study borrowing behaviors, as the item on stock can be used to study investment behaviors, etc.

adults. Data were collected online with the support of a professional survey firm[3]. The aim to target an adult population was to include individuals in different stages of their lives but to restrict the analysis to those who were already involved in the use of financial products in their lives. The use of online survey allowed to easily reach individual from different area of the country, and it has avoided the restrictions due to the safety measures required to contrast the spread of the Covid-19 virus that caused the pandemic (e.g., social distance, lockdown, etc.). The questionnaire used in the survey was developed to test how the availability of a broad set of items affects the assessment of financial literacy and explains the relationship between financial literacy and financial behaviors. Starting from the Lusardi-Mitchell questions on (1) inflation, (2) compound interest, (3) stocks, (4) bond pricing, and (5) mortgages, those five areas of knowledge were extended with five other areas, including bank accounts, payment cards, loans and debts, and insurance and retirement planning. Each of the ten areas of knowledge was addressed by five items. For each of the first five areas of knowledge, the first question was one of the Lusardi-Mitchell questions. The additional items in each group of questions differ from the Lusardi-Mitchell for their difficulty, but not for the topic. The five questions on each topic differ in terms of difficulty to test if the knowledge of the respondent goes beyond very basic principles and is enough to answer more sophisticated questions. A total of 50 items (5 questions × 10 areas of knowledge) were available to assess financial literacy. Another additional fifty items analyzed several financial behaviors. Some items collected data on money management and the use of credit cards. Other questions were about saving and investments, and debt. A special section was dedicated to student loans, and another to financial difficulties. Some questions collected information about the socio-demographic characteristics of the respondents (e.g., age, gender, education, income, job status, etc.).

The socio-demographic characteristics of the sample are summarized in Table 1.

The sample is equally balanced between male (47.5%) and female (49%) and represents all the age groups from 18 years old and older, with the over 65 a bit oversampled (15.2%). Data on education shows that the majority of

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[3] Data was collected with the support of Dynata (www.dynata.com).

Table 1. Socio-demographic characteristics of the sample

Variable	Value	%
Gender		
Male	244	47.5%
Female	252	49.0%
N.A.	18	3.5%
Age		
18-24	52	10.2%
25-30	46	9.0%
31-35	61	11.9%
36-40	44	8.6%
41-45	54	10.5%
46-50	45	8.8%
51-55	53	10.4%
56-60	44	8.6%
61-65	33	6.4%
65+	78	15.2%
N.A.	4	0.8%
Education		
Primary school (or less)	5	1.0%
Middle School	5	1.0%
High School	89	17.3%
Some college	139	27.0%
University degree	162	31.5%
Post-graduate degree	108	21.0%
N.A.	6	1.2%
Income		
Less than 15,000	77	15.0%
At least $15,000 but less than $25,000	67	13.0%
At least $25,000 but less than $35,000	68	13.2%
At least $35,000 but less than $50,000	59	11.5%
At least $50,000 but less than $75,000	91	17.7%
At least $75,000 but less than $100,000	69	13.4%
At least $100,000 but less than $150,000	42	8.2%
$150,000 or more	25	4.9%
N.A.	16	3.1%
Marital Status		
Single	187	36.4%
Cohabiting	19	3.7%
Married/Civil Partnership	221	43.0%
Separated	9	1.8%
Divorced	56	10.9%
Widow/Widover	15	2.9%
Prefer not to say	2	0.4%
N.A.	5	1.0%
Total	514	100%

the sample (79.5%) attended some college, while only 2% did not complete high school. Income is reported by eight income brackets where only the last two (from $100,000 to $150,000, and above $150,000) represent less than 10% of the sample. The most frequent marital status of the respondents is 'married or in a civil partnership' (43%), followed by single (36.4%) and divorced (10.9%). Other groups were 'cohabitating' (3.7%), 'widow/widower' (2.9%), and 'separated' (1.8%).

The five Lusardi-Mitchell questions were used to develop an index of financial literacy equal to the sum of the correct answers to these five questions. This index, used here, will replicate the findings of several previous studies (Collins 2012; Mottola 2013; Allgood and Walstad 2013) as it has been used often. Fifty items in ten areas of financial knowledge were used to measure financial literacy and then compared to the standard Lusardi-Mitchell questions. The sum of the correct answers to the five questions in the specific areas of knowledge, for each of the ten areas of knowledge, replicated the structure of the Lusardi-Mitchell index. Both the Lusardi-Mitchell and the ten specific knowledge indices have a range from zero to five. The structure, a measure of financial literacy based on five items covering the same topic with varied difficulty, allowed us to study the correlation between financial literacy and financial behaviors using financial literacy items that are strictly related to the financial behaviors. For instance, the use of credit cards might be related to financial literacy via the Lusardi-Mitchell questions - about inflation, mortgage, etc. - or by a set of five questions about credit cards. If the latter exposes a potential reverse causality issue,

it will stress the presence of a correlation between financial literacy and financial behaviors. Knowledge of credit cards should be more relevant in the explanation of the use of credit cards than knowledge about stocks or inflation. The same "five specific items" measure was developed for each of the ten areas of knowledge and provided the opportunity to test the relationship between financial literacy and financial behaviors referring to different financial behaviors. The comparison between results of the Lusardi-Mitchell index with results from the five-specific-items index can be repeated for different financial behaviors, and it will work as a robustness test of the whole comparison. In the meantime, the correct answer to the entire fifty items on financial literacy can be used as an additional comprehensive measure of financial literacy, to be compared with the previous ones. The difference between items in terms of topics and difficulty makes this "overall index" quite analytical. Because this index includes the five Lusardi-Mitchell questions it can be used to show the marginal effect produced by the increase in the number of items from five to fifty. This comparison is interesting to test the hypothesis that a correlation between financial literacy and financial behaviors exists, but a measure of financial literacy developed from just a few items may not be powerful enough to make it clear in a statistical analysis. If the fifty-item index showed a correlation between financial literacy and financial behaviors that previous studies did not find, we could conclude that the relevance of financial literacy was underestimated.

The descriptive statistics of all the financial literacy measures are summarized in Table 2.

Table 2. Financial literacy measures

Variable	Mean	Std. Dev.	Min	Max	Obs.
FL_Lusardi-Mitchell	2.72	1.66	0	5	514
FL_Interest rates	2.21	1.48	0	5	514
FL_Inflation	2.61	1.81	0	5	514
FL_Mortgages	2.45	1.75	0	5	514
FL_Investments	2.19	1.83	0	5	514
FL_Bonds	1.35	1.54	0	5	514
FL_Bank accounts	2.83	1.62	0	5	514
FL_Payments	3.26	1.69	0	5	514
FL_Savings	1.55	1.39	0	5	514
FL_Loans and Debts	2.01	1.64	0	5	514
FL_Retirement and Planning	1.48	1.16	0	5	514
FL_TOTAL	21.94	12.00	0	50	514

The average number of correct answers to the five Lusardi-Mitchell questions (2.72) indicates this index is above the average of the topic-based scores in eight out of ten cases. Only knowledge about bank accounts (2.83) and payments (3.26) seems to be bigger than the knowledge regarding the basic principles of the Lusardi-Mitchell questions (e.g., inflation, compound interest, etc.). The most critical areas - with the smallest average scores - are bonds (1.35), savings (1.55), and retirement and planning (1.48). The average value of the financial literacy measure assessed by the sum of the correct answers to all the fifty items (FL_TOTAL), is 21.94 and shows how on average Americans failed or did not know how to answer correctly 50% of the questions.

To compare the explanatory power of different measures of financial literacy on financial behaviors a set of multivariate regression models were run. Different financial behaviors related to the use of financial products or services were used as dependent variables in different sets of regression analyses. In addition, for each regression model run, the financial literacy measures were replaced, and demographic characteristics were used as control variables (e.g., age, gender, education, income, etc.). The first regression used the Lusardi-Mitchell measure. The second regression replaced it with the financial literacy measure developed using the items more closely related to the financial product/service used as dependent variables[4]. The next regression replaced again the financial literacy measure and used the sum of correct answers to all the fifty items of financial literacy. The comparison between results from step 1 (Lusardi-Mitchell) and step 2 (specific items) tested whether the use of items closely related to the financial behaviors analyzed increased the explanatory power of financial literacy and provided a robustness test for the Lusardi-Mitchell measure. The comparison between step 1 (Lusardi-Mitchell) and step 3 (fifty items) tested the differences between a small item measure (based on five items) and a larger item measure (based on fifty items). Additionally, in this case, the explanatory power of financial literacy was assessed in more detail and provided an additional robustness test for the Lusardi-Mitchell measure. The analysis was repeated for different financial behaviors (the use of different financial products and services) to guarantee the reliability of the results and to consider the possibility that results could differ when different areas of knowledge were considered.

The financial behaviors used in the analysis were: (1) the use of stocks as the main investment vehicle in an investment portfolio (InvestmentA), (2) the use of stocks or mutual funds as the main investment vehicles in an investment portfolio (InvestmentA2), (3) the availability of emergency funds for at least three months of living expenses (InvestmentB), (4) if the respondent ever tried to figure out his/her retirement needs (RetirementC), (5) the use of credit cards (PaymentD), (6) the use of any card - including credit, debit, and pre-paid cards - (PaymentsE), (7) the presence of student loans (StudentLoans), (8) the presence of any retirement account - employer sponsored pension fund, employer sponsored retirement account (e.g. 401k), any other retirement account - (RetirementTOT), (9) the use of a pawn shop to sell (PawnSell) or (10) to pawn (PawnLoan).

Descriptive statistics for these variables are listed in Table 3.

Because the independent variables were binary, the model used logistic regression for the study that, in its basic form, uses a logistic function to model a binary dependent variable. The main equations of the models are

$$\log \frac{p}{1-p} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_m x_m \tag{1}$$

and

$$\mathrm{logit}(\mathrm{E}[Y_i \mid x_{1,i}, \ldots, x_{m,i}]) = \mathrm{logit}(p_i) = \ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 x_{1,i} + \cdots + \beta_m x_{m,i} \tag{2}$$

where

$$p = \frac{1}{1 + b^{-(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_m x_m)}} \quad . \tag{3}$$

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[4] For instance, when the dependent variable was the use of stocks, the Lusardi-Mitchell index was replaced by the sum of correct answers to five questions on investments, while the sum of correct answers to five questions on retirement and planning was used to replace the Lusardi-Mitchell when the dependent variable considered the use of a retirement accounts, and so on.

Table 3. Descriptive statistics of financial behaviors

Variables*	Mean	Std. Dev.	Min	Max	Obs
InvestmentA	0.160	0.367	0	1	514
InvestmentA2	0.362	0.481	0	1	514
InvestmentB	0.558	0.497	0	1	514
RetirementC	0.424	0.495	0	1	514
PaymentsD	0.623	0.485	0	1	514
PaymentsE	0.835	0.372	0	1	514
Studentloans	0.288	0.453	0	1	514
RetirementTOT	0.634	0.482	0	1	385
PawnSell	0.298	0.458	0	1	466
PawnLoan	0.289	0.454	0	1	467

* All the variables are dummy variables equal to one if the product/service has been used (and zero otherwise)

Ⅳ. Results

The analysis of ten financial behaviors and the test of three financial literacy measures (FL_Lusardi-Mitchell, Topic-based measure, and FL_TOT) required 30 regression analyses. An additional three-model specification was added where more than one topic-based measure fit with the observed financial behavior. To preserve the readability of the paper and to focus the attention on the results related to financial literacy, the table of results (Table 4) presents only the odds ratios for the financial literacy measures[5]. Each row of the table is the output of a different logistic regression model.

The first research question was about the explanatory power of the Lusardi-Mitchell questions compared with alternative measures of financial literacy that differ in terms of (1) topics of the questions or (2) number of topics and number of items. Results show the financial literacy measure based on the Lusardi-Mitchell questions was statistically significant and confirms the positive effect of financial literacy on financial behaviors. At the same time, all the financial literacy measures based on the five topic-based questions related to financial behavior were also statistically significant each time with only two exceptions.

A. Financial Literacy and Investment Behaviors

In the first three cases, when the analysis focused on the use of stocks (InvestmentA) or "stock or mutual funds" (InvestmentA2) as the most prominent investment in the portfolio, and the presence of funds to be used for rainy days (InvestmentB), there was not a big difference between the results obtained from the Lusardi-Mitchell questions and those from the investment knowledge-based measures. The positive effect of financial literacy on financial behaviors is clear in both cases and the values of the odds are slightly higher for the Lusardi-Mitchell compared with the investment measure.

B. Financial Literacy and Retirement Decisions

A similar result was found in the analysis of whether the respondent ever figured out how much to save for retirement (RetirementC). Both the Lusardi-Mitchell (odds 1.65) and the retirement knowledge-based measures (odds 1.32) showed that higher financial literacy is associated with a higher likelihood that people thought about their retirement needs. Even in this case, there is not a big difference between the two results, and the Lusardi-Mitchell measure performed a bit better than the other. The relationship between financial literacy and retirement and planning decisions was analyzed also by another variable, where the respondent said not only if he/she thought about retirement savings, but also if he/she has an active retirement account (e.g., pension funds, 401k, IRA, etc.). In this

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[5] Details of the results are available on request by the authors.

Table 4. Logistic regression results (summary)

Mean	Range	Variables	Odds	P-value	Item
InvestmentA					
2.72	(0-1-2-3-4-5)	FL_Lusardi	1.29	0.018	
2.18	(0-1-2-3-4-5)	FL_Investments	1.11	0.210	*Most prominent investment in the portfolio···1=Stocks*
21.94	(0-1-2-···-50)	fl_tot	1.03	0.038	
InvestmentA2					
2.72	(0-1-2-3-4-5)	FL_Lusardi	1.43	0.000	
2.18	(0-1-2-3-4-5)	FL_Investments	1.33	0.000	*Most prominent investment in the portfolio···1= Stocks or Mutual funds*
21.94	(0-1-2-···-50)	fl_tot	1.07	0.000	
InvestmentB					
2.72	(0-1-2-3-4-5)	FL_Lusardi	1.68	0.000	*Have you set aside emergency or rainy-day funds that would cover your expenses for 3 months in case of sickness, job loss, economic downturn, or other emergencies*? (1=YES) (Pre-pandemic scenario)*
1.55	(0-1-2-3-4-5)	FL_Savings	1.63	0.000	
2.18	(0-1-2-···-50)	FL_Investments	1.23	0.002	
21.94	(0···.5)	fl_tot	1.07	0.000	
RetirementC					
2.72	(0-1-2-3-4-5)	FL_Lusardi	1.65	0.000	*Have you ever tried to figure out how much you need to save for retirement? (1=Yes)*
1.48	(0-1-2-3-4-5)	FL_Retirement	1.32	0.007	
21.94	(0-1-2-···-50)	fl_tot	1.08	0.000	
PaymentsD					
2.72	(0-1-2-3-4-5)	FL_Lusardi	1.77	0.000	*Which of the following payment instruments do you use? (1=Credit Card)*
3.26	(0-1-2-3-4-5)	FL_Payments	1.53	0.000	
21.94	(0-1-2-···-50)	fl_tot	1.08	0.000	
PaymentsE					
2.72	(0-1-2-3-4-5)	FL_Lusardi	1.80	0.000	*Which of the following payment instruments do you use? (1=Credit Card or Debit Card or Pre-paid card)*
3.26	(0-1-2-3-4-5)	FL_Payments	1.73	0.000	
21.94	(0-1-2-···-50)	fl_tot	1.10	0.000	
StudentLoans					
2.72	(0-1-2-3-4-5)	FL_Lusardi	0.85	0.064	*Do you currently have any student loans?*
3.26	(0-1-2-3-4-5)	FL_Payments	0.85	0.039	
2.01	(0-1-2-3-4-5)	*FL_Loansan~s*	*0.95*	*0.535*	
21.94	(0-1-2-···-50)	*fl_tot*	*0.98*	*0.124*	
RetirementTOT					
2.72	(0-1-2-3-4-5)	FL_Lusardi	1.26	0.025	*Do you have··· ... an employer sponsored pension fund? ...an employer sponsored retirement account (e.g. 401k, 403b)? ...any other retirement accounts NOT through an employer, like an IRA, Keogh, SEP, or any other type of retirement account that you have set up yourself? (Equal to 1 if at least one of those)*
1.48	(0-1-2-3-4-5)	*FL_Retirem~g*	*1.14*	*0.313*	
21.94	(0-1-2-···-50)	fl_tot	1.03	0.029	
PawnSell					
2.72	(0-1-2-3-4-5)	FL_Lusardi	0.72	0.001	*In the last 12 months - how many times did you use a pawnshop to sell an item? (Equal to 1 if at least once)*
3.26	(0-1-2-3-4-5)	FL_Payments	0.51	0.000	
2.01	(0-1-2-3-4-5)	FL_Loansan~s	0.78	0.015	
21.94	(0-1-2-···-50)	fl_tot	0.95	0.001	

Table 4. Continued

Mean	Range	Variables	Odds	P-value	Item
		PawnLoan			
2.72	(0-1-2-3-4-5)	FL_Lusardi	0.67	0.000	
3.26	(0-1-2-3-4-5)	FL_Payments	0.49	0.000	*In the last 12 months - how many times did you use a*
2.01	(0-1-2-3-4-5)	FL_Loansan~s	0.79	0.019	*pawnshop to pawn an item?*
					(Equal to 1 if at least once)
21.94	(0-1-2-⋯-50)	fl_tot	0.95	0.000	

case, the measure based on the knowledge of retirement and planning concepts was not statistically significant, while the Lusardi Mitchell confirmed its explanatory power (odds 1.26).

C. Financial Literacy and Payment Behaviors

Two financial behaviors analyzed the role of financial literacy in explaining payment behaviors. In one case, the use of at least one credit card was measured. In the second case, the use of any payment card (credit, debit, or pre-paid card) was measured. In the first case, the Lusardi-Mitchell variable (odds 1.77) and the measure of payment tools knowledge (odds 1.53) confirmed that the ownership of a credit card is more frequent for individuals with more financial knowledge, even controlling for several socio-demographic characteristics. Similar results were obtained when the analysis extended from credit cards to include the ownership of debit cards and pre-paid cards. Again, no substantial differences arise between the use of the Lusardi-Mitchell questions (odds 1.80) and the questions based on payment tools knowledge (odds 1.73).

D. Financial Literacy and Borrowing

Some differences arose when borrowing decisions are considered. The use of pawn shops seems to be explained more in detail by financial literacy measures based on payment tools than the Lusardi-Mitchell questions. When the financial behavior was the use of a pawn shop to sell an item, the knowledge on payment tools (odds 0.51) reduced the use of a pawn shop more than the Lusardi-Mitchell questions suggest (odds 0.72). Similar results were found when analyzing the use of pawn shops to pawn items (knowledge on payments odds 0.49, Lusardi-

Mitchell questions 0.67). In the third case, for the borrowing decision variables group, which considered the presence of student loans or not, the Lusardi-Mitchell questions (odds 0.85) and the knowledge based on payment (odds 0.85) indicated a similar influence of financial literacy on the use of student loans, indicating a decreased likelihood to have student loans with higher financial literacy.

Hence, we can conclude that the association of financial literacy and consumer financial behaviors could be larger than what has been estimated by previous studies using the Lusardi-Mitchell questions. This is confirmed when financial behaviors are related to borrowing. While there is not a substantial difference in the other cases (investment, retirement and planning, use of credit cards), this result can be interpreted as evidence that the Lusardi-Mitchell questions are able to summarize the financial knowledge.

E. Comparison With Previous Studies

These results differ from a study by Nicolini and Haupt (2019) that used the same analysis and the same items in the surveys presented in this study in several European countries (UK, Germany, France, Italy, Sweden). In the 25 analyses related to five financial behaviors in each of the five countries, the Lusardi-Mitchell questions underperformed the topic-based items in 19 cases, showing how a more specific measure of financial literacy performs better and highlights clearer evidence of the positive effect of financial literacy on financial behaviors.

This study also analyzed the use of financial literacy measures based on fifty items as compared to the five Lusardi-Mitchell questions. The hypothesis is that more items could enrich the informative value of the measure and investigate more in detail the knowledge of individuals in different financial topics and testing the ability to answer questions with different levels of difficulty. This measure, which was a sum of correct answers to 50 items (FL_TOT),

represents an extension of the Lusardi-Mitchell questions, adding other questions on the same topics (e.g., inflation, compound interest, etc.) and adding new areas not covered by the Lusardi-Mitchell questions (e.g. retirement and planning, bank accounts, payment cards, etc.). The difference in the scale of the two measures (zero to five and zero to fifty) called for an adjustment to the value of the odds given the average value of the Lusardi-Mitchell measure was 2.72, while the average of FL_TOT was 21.94. This latter measure is intrinsically more powerful. A rule of thumb to bypass the difference in scale between the two measures is to leverage by ten (the ratio between the two scales: fifty and five) the distance from the unit of the digits to the right of the decimal point of the FL_TOT odds[6]. In the case of the use of stocks as the main investment tool in a portfolio (InvestmentA) the Lusardi-Mitchell measure (odds 1.29) and the FL_TOT (odds 1.03...rescaled to 1.30) indicates quite similar results. When the analysis is enlarged from stocks to mutual funds (Investment2A) the Lusardi-Mitchell odds (1.43) tended to underestimate the effect of financial literacy measured by the FL_TOT (odds 1.07... rescaled to 1.70). The analysis of the presence of rainy days funds (Lusardi-Mitchell (odds 1.68) and the FL_TOT (1.07...rescaled to 1.70) showed similar results, as did the retirement (for RetirementC) Lusardi-Mitchell (odds 1.65) and the FL_TOT (1.08...rescaled to 1.80), for (RetirementTOT) Lusardi-Mitchell (odds 1.26) and the FL_TOT (odds 1.03...rescaled 1.30). The results for credit cards for Lusardi-Mitchell (odds 1.77) and the FL_TOT (1.08...rescaled to 1.80); for credit/debit/pre-paid cards for Lusardi-Mitchell (odds 1.80) and the FL_TOT (1.10...rescaled to 2.00); for student loans for Lusardi-Mitchell (odds 0.85) and the FL_TOT odds (0.98... rescaled to 0.80); for pawn to sell for Lusardi-Mitchell (odds 0.72) and the FL_TOT (0.95...rescaled to 0.50); for pawn to loan for Lusardi-Mitchell (odds 0.67) and the FL_TOT (0.95...rescaled to 0.50) complete the comparison.

Overall, the Lusardi-Mitchell measure works as a good proxy for the measure with the additional 45 items. Except for the use of pawn shops, the results for the Lusardi-Mitchell questions do not differ substantially from the results for the FL_TOT questions. This result demonstrates the reliability of the financial literacy measures based on the Lusardi-Mitchell questions. Despite the use of a small set of items, the Lusardi-Mitchell questions do not fail to assess the effect of financial literacy on financial behaviors. This conclusion differs a lot from the one from Nicolini and Haupt (2019). Using the same questionnaire and the same methodology the authors found in a sample of European countries where the Lusardi-Mitchell questions widely underestimated the effect of financial literacy when analyzed against the fifty-item scale. The difference in this result may be explained by the difference in the sample. A possible explanation is that the financial knowledge of Americans is more homogeneous across the different areas of knowledge, making the Lusardi-Mitchell align better with the average scores based on fifty items. Other differences could be related to financial behaviors. For instance, the use of stocks as investment tools could be more common in some countries than others - as well as the use of credit cards - making a financial literacy measure based on few items perform just as well as a measure based on fifty items in some countries but not in others.

V. Conclusions

This study dealt with the reliability of financial literacy measure used in previous studies and referred as the Lusardi-Mitchell questions, based on a small number of items related to different financial topics. The availability of a broad range of financial literacy items allowed us to test whether a measure of financial literacy based on items, all logically related to a certain financial behavior, worked better than the standard five items (the Lusardi-Mitchell questions) in explaining the influence of financial literacy on financial behaviors. Results from the American sample did not show a substantial difference in the explanatory power of the Lusardi-Mitchell compared with "specific-topic" financial literacy measures. The fact that the Lusardi-Mitchell questions were introduced for the first time in survey that target Americans and were developed to summarize the financial literacy of these individuals can be a possible explanation of this results. However, further investigation could better explain it. This result allows researchers to consider the Lusardi-

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[6] Doing so a odds equal to 1.03 can be rescaled to 1.30 (1+ [1.03-1] × 10) and a odds equal to 0.98 can be rescaled to 0.90 (1+ [1-1.02] × 10). At the same time, the average of the FL_TOT should be rescaled from 21.94 to 2.194.

Mitchell questions as an effective measure of financial literacy even when some of the items do not have a logical connection with the financial behavior analyzed (e.g., stock market participation and the item on mortgages). A second test compared the Lusardi-Mitchell measure - based on the sum of correct answers to the five items - to a measure based on fifty items (including the five Lusardi-Mitchell). This was done to test if the effect of financial literacy could be underestimated by using a small number of items. Results from the Lusardi-Mitchell questions do not perfectly match the results from the fifty-item scale, but the difference between the two was small enough to reject the hypothesis that results from previous studies could be biased by the small size of the financial literacy measure. The only concern is for the use of a pawn shop, where the effect of financial literacy assessed by the Lusardi-Mitchell underestimates the effect measured by the fifty-item scale. It is interesting to note how these results based on a US sample differ from the one estimated in Europe by Nicolini and Haupt (2019). These authors have found that the availability of a broad set of financial literacy items helped to develop specific-topic measures and measures based on a large number of items that improve the quality of the results and show a more relevant role of financial literacy in explaining financial behavior than what has been found in previous studies.

Results from the present study increase the reliability of results from previous studies when the measure of financial literacy was based on the Lusardi-Mitchell questions. Despite that the measure is (1) based on only a few items, (2) cannot address specific competences, and (3) cannot consider all the different areas of knowledge in finance, it can provide similar results to more specific measures or measures based on a more generous number of items. However, the limited sample size and the fact that differences between countries can make the financial literacy of an individual be relevant and crucial to take some financial decisions in a country, but not as much in others, represent a limitation of this study and suggest replicating it addressing different geographical areas. Additionally, results from this paper support the hypothesis that the financial literacy affects financial behaviors and support financial educators and policy makers promoting financial education, under the assumption that improving financial literacy through financial education we can improve the quality of consumers' financial behaviors.

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