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Who Prefers Guessing to Admitting They Don't Know? Measurement Error in Financial Literacy Surveys

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Who Prefers Guessing to Admitting They Don't Know? Measurement Error in Financial Literacy Surveys

Abstract

A propensity to guess randomly rather than to admit ignorance answering “Don’t know” is a plausible reason why frequent wrong answers are given to survey questions that aim to assess competence. We model this source of measurement error and assess its empirical relevance in two consecutive waves of a survey of financial literacy. Misclassification of standard financial literacy indicators is very likely, especially in some demographic groups. Respondents who answer correctly in both waves of the survey are less likely to have guessed in the first wave, and have a lower probability of reporting financial difficulties than those who guessed and were lucky enough to appear literate.

JEL-Codes: D140, D830, G510, G530.

Keywords: misclassification, guessing, financial literacy, financial resilience.

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1. Introduction

A vast literature studies measurement error in surveys (Wikman and Warneryd, 1988; Biemer, 2009; Tourangeau, 2021; Celhay et al., 2024). Reliability of survey indicators is low when inconsistent responses are recorded in repeated answers to the same question or in answers to related questions. This may be due to poor design of questions and questionnaires, mistakes in data processing, insufficient quality control, inadequate interviewer training. It may also reflect structural features of the process that generates individual survey responses if, for instance, when formulating opinions or expressing preferences, a respondent's limited attention may randomly focus on subsets of the many different possible considerations that bear on a complex issue. The literature also studies the sources and information content of "Don't know" (DK) answers. Designers of opinion and preference surveys generally try to prevent such responses because, if interpreted as a sign of laziness, confusion, or refusal to answer, they must be coded as missing values (Krosnick, 2002; de Leeuw et al., 2016). A DK response option should however be offered for low salience issues, on which respondents may have no precise views, or for questions that aim to assess competence, to allow respondents to admit ignorance (Durand and Lambert, 1988; Nadeau and Niemi, 1995; Elkjær and Wlezien, 2024).

This paper formulates a model of measurement error when some survey respondents prefer guessing to admitting ignorance. In that situation, coding the DK option as a missing value would be inappropriate when it is an honest admission of ignorance. And it would be equally inappropriate to classify as competent a respondent who refrains from admitting ignorance and randomly guesses the correct answer. To assess the empirical relevance of this source of measurement error we consider a specific application to financial literacy, and exploit two consecutive waves of a survey on financial literacy and resilience of Italian households during the Covid-19 pandemic.

Using the standard definition of financial literacy based on answers to the "Big Three" questions on interest rate, inflation, and risk diversification developed by Lusardi and Mitchell (2011), we document that financial literacy appears to be poorly measured. Almost a third of the respondents who in one year answered correctly all three questions

made at least one mistake just a year after. Many data-generating processes may underlie poor survey assessment of supposedly stable financial knowledge. We focus on the propensity to answer randomly rather than admit ignorance, which offers an interesting interpretation of reliability statistics. To assess the relevance of this mechanism we formulate a structural model of random answer patterns, study its empirical explanatory power for the variation across surveys of apparent literacy, and see how the measurement error it implies influences the empirical relationship between financial literacy and financial outcomes.

The empirical approach relates to the vast literature documenting that financial literacy matters to personal finance and, less obviously, to public decisions (see, e.g., Lusardi and Mitchell, 2023; Lo Prete, 2024; Fornero and Lo Prete, 2023). The results offer insights on the relevance of lack of confidence in self-assessed financial competence and other personal characteristics to financial behavior. Research finds that female respondents tend to disproportionately respond DK to questions measuring basic financial competence and that their lack of confidence, rather than knowledge, may overestimate the gender gap in financial literacy (Bucker-Koenen et al., 2021; Cziriak et al., 2024; Hospido et al., 2024). In our data the estimated propensity to guess is high and similar for both genders for the easiest numeracy question. It is lower for both genders for inflation, a concept that males appear more likely to grasp correctly. Females who answer the risk diversification question appear to do so competently as often as males and guess much less frequently. Thus, the propensity of males to guess rather than admitting ignorance is higher and can be part of the explanation for the observed gender gap in financial literacy. The results are also relevant to overconfidence and excessive trading research (Daniel and Hirshleifer, 2015; Inghelbrecht and Tedde, 2024): we find that respondents who report high self-assessed competence are more likely to know the correct answer, but if they do not know it they are more likely to guess rather than to admit ignorance.

Like all data, financial literacy indicators are imperfect, and measurement errors make it difficult to assess the empirical effects of true financial competence on financial choices and other outcomes of interest. In regressions that relate indicators of financial resilience to financial literacy, our model of guessing behavior suggests that financial

literacy regressors that exploit repeated answers are more reliable than standard ones. We indeed find that respondents who consistently answer correctly are less likely to experience financial difficulties than those who guess correctly in the first wave and answer incorrectly one year after. We also find that exploiting the structural information provided by the repeated answers available in our data yields more reliable results than other methods of dealing with measurement error in cross-sectional financial literacy data (van Rooji et al., 2011; Gignac and Ooi, 2022; Bottazzi and Oggero, 2023).

The literature on measurement error also finds that indicators constructed from survey responses are noisy when answer options are very similar to each other (Schuman and Presser, 1996; Tourangeau et al., 2000). In our empirical application, we note that dependent variables may be noisy if they are coded on the basis of a subtle distinction between “probably” and “probably not” being able to cope with an unexpected expense (as in Clark et al., 2021). When that financial fragility indicator is the dependent variable, the coefficients of standard financial literacy indicators are indeed less significant than they are when the dependent variable is coded on the basis of respondents being “certain” to be unable to meet unexpected expenses. The point estimates also appear to be biased, because they are smaller than those obtained using more reliable indicators of financial literacy. This suggests that the measurement error in regressors induced by guessing behavior is correlated with the errors induced in the dependent variable by subjective probability assessments.

The paper proceeds as follows. Section 2 introduces the data we use and offers some motivating evidence. Section 3 presents the structural model we develop to study the propensity to pick up a response randomly rather than admitting ignorance. Section 4 presents the results from regressions linking financial resilience to indicators of financial literacy and guessing behavior. Section 5 compares our methodology to deal with measurement error in financial literacy with previous approaches. Section 6 makes the case of measurement error due to question wording. Section 7 concludes.

2. Motivating evidence

We use data from two consecutive waves of a survey on financial literacy and resilience of Italian households administered by the Italian Financial Education Committee in

collaboration with Doxa on a yearly basis starting in May-June 2020. In all waves, the person responsible for the economic decisions of the household provides socio-demographic information, details on the economic situation of the household, and answers to standard questions on basic financial competence. The first two editions of the survey, in particular, offer a rare opportunity to observe a large sample of 4,027 households over time (Doxa, 2020 and 2021).¹

The descriptive statistics for all variables used in our analysis (in Table A1) and the exact wording of the questions we use is available in the Appendix. Following Lusardi and Mitchell (2011), we define financial literacy based on how respondents answer the Big Three basic questions on interest rate (numeracy), inflation, and risk diversification. Each question includes the DK option and two or three other options, among which one is correct. We summarize the information they provide with an equally standard indicator: a dummy set to unity if the person responsible for managing economic matters in the household appears “literate” by answering correctly all three questions, to zero otherwise.

As we observe the same households in two consecutive waves, we can track answers to each question over time. In 2020, 45% of the respondents answered correctly all the three basic questions. Strikingly, almost one third of those respondents made at least one mistake just a year after. If we code as literate only those who continue to appear literate in 2021 (71% of the 45% coded literate in 2020), the share of financially literate respondents is 13 percentage points lower at 32%. This is close to the 37% of Italian households who appear literate in the 2014 Standard & Poor's Ratings Services Global Financial Literacy Survey based on a more generous definition (Klapper and Lusardi, 2020), and provides an arguably better approximation to the prevalence of financial literacy in Italy.²

¹ Out of about 5,000 households interviewed online, the redemption rate in 2021 was 80,4%. The person in charge of economic decisions might in principle be different in the two waves; in practice the age, gender, education and other socio-demographic characteristics confirm that the respondent is the same person in the two waves.

² The 2014 Standard & Poor's Ratings Services Global Financial Literacy Survey collects individual data and provides data on financial literacy in more than 140 countries, defining literate those who answer correctly *to three out of four* questions on interest rate, inflation, risk diversification and interest compounding.

In Figure 1 pairs of histograms display, for the full sample and subsamples defined by demographic characteristics and self-assessed financial competence, the percentage of households providing correct answers on all the Big Three questions in 2020 (dark bars) and the percentage of households providing correct answers on all the Big Three questions both in 2020 and 2021 (light bars). Across population subgroups the difference between the two percentages is remarkably similar at about 13 percentage points to that observed in the overall population.

Both percentages do vary together across sub-groups. We observe the same sharp differences by gender that previous studies attribute to women's lower knowledge and lower self-confidence (Bucher-Koenen et al., 2017; Bottazzi and Lusardi, 2021; Tinghög et al., 2021). Knowledge of basic economics and finance is low among the young and increases in age, confirming the findings in Bottazzi and Oggero (2023): financial literacy in the Italian population does not follow the hump-shaper pattern that other scholars find in US or worldwide surveys. Financial literacy is higher among respondents who hold a College degree or higher, and among respondents who value their competence "sufficient" (6 or more points on a rating scale from 0 to 10).³ In our empirical work we allow those differences to depend also on different propensities to guess, sometimes answering incorrectly, sometimes being lucky and picking the correct answer.

Table 1 reports statistics on correct, DK, and incorrect answers separately for the three questions on interest rate (numeracy), inflation, and risk diversification. We also exploit and report novel information on the difference between answers that are correct in 2020 but incorrect in 2021. As in previous research, correct answers become less frequent as questions become more difficult (from interest rates, to inflation, and risk diversification). The fraction of DK answers and the fraction of incorrect answers are related in possibly interesting ways. On interest rates and inflation, female respondents more often admit ignorance and also more often give incorrect answers than males. On

³ Education at school does not necessarily imply higher financial knowledge and better personal finance (Lo Prete, 2018) if the curricula do not include specific modules on economics and finance. In practice, however, those who accumulated more general human capital also show a better understanding of financial concepts (Lusardi and Mitchell, 2023).

the more difficult risk diversification question, conversely, females admit their ignorance more often than males, but males answer incorrectly more often. A larger percentage of all age groups admits ignorance on risk diversification than on easier questions. On all questions, respondents with a college degree or higher are less likely to admit ignorance, but make as many mistakes as less educated respondents. Those who think their level of financial knowledge is sufficient are two or three times less likely to admit ignorance and give wrong answers more often. This is consistent with the finding in psychology that flawed self-assessment implies mistakes for individuals who are too optimistic about their skills and expertise (Dunning et al., 2004).

The percentage of “correct in 2020 but incorrect in 2021” varies across questions. It is smallest at 9 for answers to the question on inflation by the oldest, who do not appear to suffer cognitive decline (Boyle et al., 2013) in these data. It is largest at 15 for the young on the numeracy question and for females on all questions (the gender gap is stable across topics as found by Yakoboski et al., 2022, and Klapper and Lusardi, 2020). Comparing those who hold a college degree and those who do not, and those who self-assess their financial competence as sufficient to those who do not think it is sufficient, that percentage is sharply lower for the easiest question on interest rate, rather similar for the other questions.

3. A structural interpretation

Suppose that each individual either knows or does not know the answer, and neither forgets nor learns anything across waves of the survey: there is a fraction p of individuals who know the answer to a question. Suppose also that individuals who do not know the answer to a question may not admit it: they reply DK with probability $1 - q$, or pick one of the other answers randomly with probability q . The random answer may or may not be incorrect.

Another source of incorrect answers is the fact that respondents who (think they) know the answer can make mistakes: denote s the probability of an incorrect answer by a respondent who intends to answer correctly. We exclude the possibility that individuals who know the answer reply DK. These different sources of wrong answers can have different implications. Those who think they know but confidently give wrong answers,

for example because they are convinced that higher inflation increases real return at given nominal rates, probably also make mistakes in real life. Those who are aware of being ignorant and still answer randomly may not do that when the stakes are real. The average propensities to guess q and make mistakes s need to be assumed constant across individuals in a sub-sample. They could more generally be a function of observable individual characteristics, including self-assessed competence.

Recall that p is the fraction of respondents who think they know the answer, of which $1 - s$ pick it correctly. If failing to respond correctly is due to ignorance rather than to distraction or carelessness,⁴ the fraction of ignorant respondents is $p(1 - s)$. As the others reply DK with probability or frequency $(1 - q)$, in the data the fraction D of DK answers is

$$D = (1 - q)(1 - p). \quad (1)$$

This expression relates the empirical frequency of DK answers to q and p , and a similar expression can be derived to relate the empirical frequency of wrong answers to the same two parameters and s . Denoting M the number of possible answers other than DK, the predicted fraction of wrong answers W sums that of individuals who know they do not know but with probability q guess, and pick the wrong answer with probability $(M - 1)/M$, and that of the individuals who think they know but, with probability s , give an incorrect answer:

$$W = q(1 - p)(M - 1)/M + ps. \quad (2)$$

Expressions (1) and (2) form a system of two equations, with solution

$$p = 1 - \frac{M(W - s) - D(1 - M)}{M(1 - s) - 1}$$

and

$$q = \frac{W - s + sD}{W - s + \left(\frac{M - 1}{M}\right)D}.$$

⁴ Both types of wrong answers when a DK option is available can simply reflect carelessness. Because incorrect answers to surveys have no real consequences for the respondents, they are likely to give them if they find it unpleasant to concentrate and find the right answer or find it uncomfortable to admit ignorance, which is perhaps more likely if they claimed high competence when answering a previous question.

These expressions make it possible to estimate the truly competent fraction of respondents and of the propensity to guess as a function of the empirical frequencies of wrong and DK answers, of the number of optional answers M , and of s .

Unfortunately, q and s are not separately identified by the empirical fractions of DK and incorrect answers in subsamples. To get a sense of what the data say about the prevalence of competence and propensity to guess, suppose that $s = 0$, i.e. respondents who think they know the answer to a question do reply correctly with probability one. Inserting the frequencies \widehat{W} and \widehat{D} observed for some questions and subsamples in these expressions with $s = 0$ yields

$$\hat{p} = 1 - \frac{M}{M-1} \widehat{W} - \widehat{D} \quad (3)$$

and

$$\hat{q} = \frac{\widehat{W}}{\widehat{W} - \frac{1-M}{M} \widehat{D}} \quad (4)$$

as the values of true competence (supposed constant over time) and propensity to guess that can explain why surveyed individuals appear to forget the answer to questions they answered correctly before. Intuitively, as \widehat{D} tends to zero the estimated propensity to guess \hat{q} tends to unity if \widehat{W} is positive, and the estimated probability to know \hat{p} adjusts the wrong answers to account for correct guesses.

We can estimate the probability to know p and of the propensity to guess q using the information in the sample of Italian households who participated in the survey in 2020 and 2021 by substituting the empirical fractions \widehat{D} of DK answers and \widehat{W} of incorrect (wrong) answers in equations (3) and (4). Table 2 shows the estimated probability to know and propensity to guess. The fraction \hat{p} of individuals who know the answer is higher for easier questions.⁵ For each question it is higher for males, for individuals aged 50 or more, for those with a college degree, and for those who think their financial competence is sufficient. Again, the gender gap is much smaller for the most demanding concept of risk diversification.

⁵ Correct guesses are less likely when the number of options M is larger, but the question with fewer options (about risk diversification) is more difficult.

The estimated probability to know \hat{p} ranges between 35% and 72%. If the data generating model is correct this means that the complementary fraction does not know the correct answer, and explaining the many wrong answers in terms of propensity to guess requires very high values of \hat{q} . It is also interesting to find that the propensity to guess is higher for easier questions: about 80% of those who do not know the answer to the very basic numeracy question prefer guessing randomly to giving a DK answer; on the more difficult question about risk diversification the estimated propensity to guess is lower, albeit still high at over 50%, which suggests that the kind of mistakes parameterized by s may also play a role in generating the survey data.⁶

The estimates in Table 2 vary across demographic characteristics. In particular, females are less inclined to guess than males on all questions. Older respondents guess more than other age groups on the most difficult questions on inflation and on risk diversification. Higher educational achievement is associated with a higher probability to know \hat{p} , but also to a higher propensity to guess \hat{q} . Similarly, a more positive evaluation of personal financial knowledge is associated with better actual competence, and with the highest propensity to guess and be wrong on each question.

The data generating model we developed can be used to interpret the apparent changes of the competence assessed by correct answers to all the Big Three questions. To see this, suppose individual i knows the answer to n_i of N questions, and replies correctly to those questions with probability one, i.e. $s = 0$. To the other $N - n_i$ questions the individual with probability q_i randomly picks one of the M multiple choices, and otherwise gives the honest DK answer. Because the guess is correct with probability $1/M$, for each of these questions the observed answer is correct with probability q_i/M , and the probability that x of these answers are correct is given by the binomial expression

$$p_x = \frac{(N - n_i)!}{x! (N - n_i - x)!} \left(\frac{q_i}{M}\right)^x \left(1 - \frac{q_i}{M}\right)^{N - n_i - x}.$$

⁶ Large values of either parameter play similar roles in rationalizing the presence of wrong answers when it is possible to admit ignorance. While in expression (3) a larger s requires a larger q to explain the data when more than $(M-1)/M$ of those who give an answer get it wrong, in our data the fraction of wrong answers is about 20%, and much lower than the 66% or 50% values of $(M-1)/M$. Hence, allowing for a positive fraction s of individuals who think they know the right answer but answer incorrectly reduces the estimated q fraction of those who do not know it but answer randomly anyway.

This makes it possible to gauge the intensity of the misclassification implied by reluctance to admit ignorance for the standard measurement strategy that considers "financially literate" those who know the answer to all the Big Three questions.⁷ An individual who ignores the answer to all the three questions but randomly picks one of three possible answers guesses all three correctly with probability 3.7%. One who knows only one answer guesses the other two correctly with probability 11.1%. And one who knows only two answers guesses the remaining one correctly with probability 33.3% (and 50% if the guessed question has only two possible answers, like the more difficult question on risk diversification). Recalling that ignorant respondents have a propensity to guess higher than 50% for the more difficult questions and up to 78%, the probability that such individuals are misclassified as fully literate is quite high. For example, if we assume that one third of the individuals know all three answers to questions with three options, and that an equal fraction of the others guesses 1, 2, and 3 answers with probability $q = 0.66$, then almost 11% of the latter will be classified as financially literate. This is similar to the approximately 13 percentage points difference between those who appear literate in 2020 and those who appear literate in both 2020 and 2021 in Figure 1. It is a little lower, indicating that the share of individuals who know 1 or 2 answers (and are more likely to be misclassified when guessing correctly the other 2 or 1 answers) is plausibly larger than one third.

Misclassification is of course much less likely when appearing literate requires correctly guessing twice as many questions, and this explains why they no longer appear to be so competent in their answers to the next wave of the survey. For those who guess 3, 2, 1 answers in both surveys the probabilities of giving all six correct answers are much smaller at 0.14%, 1.23%, and 11.11%, and overall just 2.75% are misclassified as literate when their propensity to guess is equal to 66%.

⁷ Some research assesses financial literacy in terms of the number of correct answers to three questions, and code as missing DK responses. Respondents who guess an answer obtain a higher score than if they had answered DK with probability 1/3, the same score with probability 2/3, so their score is higher on average. If an older interviewer induces more reluctance to admit answers, this perspective on the data-generating process might explain why Crossley et al. (2020) detect some evidence that older interviewers elicit higher and less variable financial literacy scores. Unfortunately, our data provide no information about interviewers.

4. Empirical implementation

For any given set of structural assumptions, assessment of financial literacy on the basis of repeated answers is more reliable because misclassification requires twice as many correct guesses. Computing exactly the overall probability of misclassification would be extremely complicated. It would not only be necessary to account for the variable number of possible answers across questions (two of the Big Three questions offer a choice of three answers, the other just two, besides DK), but also to make many debatable assumptions about variable propensity to guess across individuals and questions to which different numbers of individuals know the answer.⁸

The empirical models we run and report below more simply regress the household's (lack of) financial resilience on indicators of financial competence and economic and socio-demographic control variables. The data-generating model implies that observed financial literacy depend on true competence as well as on propensity to guess. In the regressions both these underlying factors vary across respondents and both, along with unobserved characteristics, may influence financial outcomes. We report linear probability models where regressors include financial literacy measured in the standard way in 2020 (dummy "Correct on all Big Three in 2020", coded one if the Big Three are all answered correctly, zero otherwise); a variable that detects possible random guessing (dummy "Guessed at least one in 2020", coded one for respondents who appear literate in 2020 but, based on their answers to the same questions one year after, seem to have just made lucky guesses, zero otherwise); and a measure of financial literacy that we expect to delete most of the misclassification due to lucky guesses (dummy "Correct on all Big Three in 2020 and 2021", coded one only if all answers are correct in both years, zero otherwise)

To assess lack of financial resilience we use information on whether the income of the household covers expenses until the end of the month (De Bruijn and Antonides, 2020; Sconti, 2024). The variable "difficulty to make ends meet" is a dummy that equals

⁸ Even if a convincing estimate of the overall probability r of misclassification could be computed, the variance $r(1-r)$ of the financial literacy dummy's measurement errors would not be straightforwardly related to the resulting bias of its estimated coefficient. Because discrete misclassification is not the same as additive measurement errors, their empirical implications are more complicated than the classic errors-in-variables attenuation bias (Höfler, 2005).

unity if in 2020 the respondent states that the household's income covered expenses until the end of the month "with great difficulty", "with difficulty" or "with some difficulty", zero if the respondent chooses the other options ("fairly easily", "easily" or "very easily"). In the sample, a large 57% fraction of respondents admitted difficulty to make the ends meet. Among them 39% appear financially literate by answering correctly the big three questions on numeracy, inflation, and risk diversification in 2020. Only 25% repeated this performance responding to the same questions correctly in 2021.

The results in column 1 of Table 3, where we use the standard definition of financial literacy based on correct answers to all the Big Three questions in 2020, document a negative and significant association between basic competence and the dependent variable: households where the person in charge of managing financial matters answers correctly to the Big Three questions in 2020 are less likely to have difficulty to make the ends meet. In column 2 we add the variable "Guessed" measuring if the respondent gave a correct answer to all the Big Three questions in 2020 but not in 2021, which attracts a negative and significant coefficient. The estimated coefficient of financial literacy is more negative than in column 1 and similar to the coefficient in column 3 of the index of financial literacy based on correct answers in both 2020 and 2021.

The guessing behavior we model implies that the financial literacy indicator in column 1 misclassifies as competent respondents who guess correctly, and readily suggests an interpretation of these findings in terms of standard attenuation bias. Because measurement of financial literacy is more precise in columns 2 and 3, estimated regression coefficients are farther from zero, and offer less biased and more significant estimates of the effects of interest.

The significance and sign of the socio-demographic covariates is similar in all columns. The gender of the respondents in charge of financial decisions in the household does not seem to matter.⁹ Respondents who are 50-64 years old, live with minors or invalids in the households, and/or in the South of Italy, Sicily or Sardinia are more likely

⁹ This result is similar to those in Bertola and Lo Prete (2024) who explore the relevance of financial literacy to consumption risk sharing in the same dataset. Sconti (2024) also finds no evidence of a gender bias when analyzing the relationship between having trouble making the ends meet and financial literacy before the Covid-19 pandemic on data from the Bank of Italy's Survey on Household Income and Wealth.

to have some difficulty to make the ends meet, which is less likely for respondents with higher income, own their house, and have a College degree or higher.

5. Alternative methods

The regression in column 3 of Table 3 exploits repeated answers to obtain a financial literacy indicator that mostly depends on true competence, and arguably obtains a reliable estimate of its financial outcome implications. In this section, we proceed to compare the pattern of results in Table 3 with those estimated on the same 2020 data by methods that previous research used to correct for measurement error in financial literacy indicators from a cross-sectional survey.

Depending on the type of behavior under analysis and on data availability, researchers use different definitions of financial literacy. Besides the Big Three questions, larger sets of four or five or up to dozens of questions can define wider concepts of “financial education”.¹⁰ Noting that more complicated questions elicit high fractions of DK answers, van Rooji et al. (2011) extract an underlying principal factor from a set of variables that code correct, incorrect and DK answers separately. In the same spirit, we construct two dummy variables for each question: one coded to unity when respondents gave a correct answer and zero otherwise, another coded to unity when the respondents answered incorrectly and zero otherwise; both are coded zero if the answer was DK. Table A2 in the appendix reports the principal factor’s loadings estimated only on the three dummies for correct answers (merging together DK and incorrect answers). Table A3 reports loadings estimated on all six dummies for correct and incorrect answers (which allows incorrect answers to play a role distinct from that of DK answers). The signs are those that would be expected if those factors measured underlying financial competence: positive for correct, negative for incorrect answers.¹¹

¹⁰ Over time, several composite “barometers” have been developed to measure the relevance of financial education to financial well-being. For instance, the annual report on the TIAA Institute-GFLEC Personal Finance Index Annual Report includes 28 questions across eight areas of functional knowledge, namely borrowing, saving, consuming, earning, go-to info sources, investing, insuring, comprehending risk (see e.g. Yakoboski et al., 2022).

¹¹ van Rooji et al. (2011) code the additional dummies to unity for DK answers, so our wrong-answer dummies are omitted. That approach estimates factor loadings with opposite signs.

In Table 4 the regression in column 1a includes the principal component of the three correct answers to the Big Three questions. The regression in column 1b includes the principal component of the six dummy variables of correct and incorrect answers to the Big Three questions. While the coefficient estimates are not directly comparable to the ones from previous analyses in Table 3, it is interesting to find that they are both less significantly different from zero than the one of our refined measure of financial literacy in column 3 of Table 3. More importantly, the point estimate and significance of the principal components are very similar in columns 1a and 1b: when reluctance to admit ignorance plays the role we document in the data generating process, there is no theoretical reason why the principal component of response patterns that include DK should measure competence (rather than incompetence or propensity to guess). In our data, it does not appear to do so.

Next, we consider how our results relate to the literature on internal consistency and reliability of financial literacy indicators. According to Gignac and Ooi (2022), the impact of financial literacy on outcome variables can be underestimated unless financial literacy tests with a minimum of 13-15 questions are available to mitigate measurement error (Gignac and Ooi, 2022). In the same spirit, we can obtain more reliable indicators not only by observing answers to the same questions over time, but also by considering the answers to more numerous questions at the same time.

Besides the standard Big Three questions analyzed above our dataset features three other questions on interest compounding, mortgage, and return on risky investments (see the Appendix for exact wording). The fraction that answers all six correctly should be lower than that which answers the Big Three correctly, for two reasons. One is that the additional questions test more advanced knowledge, so fewer respondents are truly literate at that more sophisticated level. Moreover, the fraction of misclassified illiterate respondents who luckily guess the correct answer should also be lower, because the probability to pick all the correct options is lower when questions are more numerous. The high propensity to guess we document in our data explains why the index of financial literacy that codes as literate respondents who answer correctly all the six questions available in 2020 attracts a larger and more significant point estimate in column 2 of Table 4 than the standard financial literacy indicator in column 1 of Table 3. However,

the estimates are somewhat less significant than those obtained by considering correct answers in both 2020 and 2021 (column 3 of Table 3), as this approach imperfectly reduces the measurement error induced by reluctance to admit ignorance.

Finally, we consider instrumental variable estimation methods. Financial outcomes and the ability to answer the survey correctly may of course be jointly driven by underlying individual characteristics that are not directly observed. This problem could be corrected by instrumental variables that are strongly correlated with financial literacy and can be credibly excluded from the regression. It is generally difficult to find and defend such identifying restrictions, and no valid instrument is available in the survey we are using. In the presence of mismeasurement due to guessing, however, to ameliorate attenuation bias it suffices to use instrumental variables that are less correlated with measurement errors than with true financial literacy. Following Bottazzi and Oggero (2024), who analyzed the 2021 wave of our survey, we use Lewbel’s (2012) estimation method that exploits first-stage heteroskedasticity, rather than traditional exclusion restrictions, to construct instruments as functions of the model’s data.¹² This appears to remove some measurement error: as is usually the case in the literature reviewed by Lusardi and Mitchell (2014), the coefficient of instrumented financial literacy reported in column 3 of Table 4 is larger than the basic estimate in column 1 of Table 3. The coefficient is also somewhat larger but much less precisely estimated than the estimate in column 3 of Table 1, which by exploiting information from repeated answers to the Big Three questions more clearly and structurally removes measurement errors caused by guessing.

6. Survey wording

In this section we test whether small changes in the wording of survey questions can subtly change how participants respond to questions, often in unintended ways by focusing on the outcome variable and its definition.

“Difficulty to make ends meet”, the dependent variable in Tables 3 and 5, has the advantage of offering options that distinguish being or not being able to make ends meet,

¹² We use the Stata command `ivreg2h` to generate excluded instruments from the first-stage residuals multiplied by each of the included exogenous variables in mean-centered form.

without including a DK option. Other questions aim to uncover similar information but are not always posed and answered in ways that convey it clearly. We illustrate this issue considering two ways of coding a “financial fragility” dependent variable based on a frequently used survey question that assesses how difficult it would be to face a financial emergency, with possible responses “I am certain I could”, “I probably could”, “I probably could not”, “I am certain I could not” (Lusardi et al., 2011).

We first follow standard practice and set to unity a dummy for respondents who say they “are certain they could” or “probably could” be able to come up with € 2,000 if an unexpected need arose, zero otherwise, and exclude those who answered DK from the sample. According to this definition 31% of Italian households were financially fragile after the outbreak of the Covid-19 emergency. Of them, 32% were financially literate in 2020, 20% in both 2020 and 2021, about 5% did not know the answer to the question. This definition draws a fine line between those who “probably could” and those who “probably could not” come up with € 2,000 and elicits answers that depends on the respondent’s sense of what “probably” means. We also consider a more stringently defined dummy variable that equals zero for all respondents who are certain they would be able to come up with those € 2,000, and unity for all the others. Because about a third of respondents report that they “probably could” put together € 2,000, the 62% fraction of financially fragile households using this definition is almost twice that of financially fragile households according to the looser definition, and similar to that of household who were not able to make ends meet at the end of the month, even though the two subsamples overlap only partially.

As in the regressions that Bottazzi and Oggero (2023) run on the 2021 wave of the survey, in columns from 1 to 3 of Table 5 financial fragility is less likely for households that according to the standard “looser” definition appear financially literate because they answer correctly the Big Three questions in 2020. Financial literacy indicators that exploit information from correct answers in 2020 and incorrect answers in 2021 do not appear to offer different information as an explanation of financial fragility. In column 2, the estimated coefficient of guessing correctly is insignificantly different from zero. In column 3, the refined indicator that considers literate only respondents who answer all questions correctly both in 2020 and in 2021 has a very similar coefficients to that

reported in column 1. The pattern of results suggests that drawing a distinction between “probably” and “probably not” introduces noise in the dependent variable, which reduces the significance of estimated coefficients, and biases them to the extent that measurement errors are correlated across the dependent and explanatory variables. The sharper “certain” wording of the more stringent definition of financial fragility is less noisy. The pattern of results it yields in columns 4-6 of Table 5 is similar to that which in Table 3 conforms to the data generating process we model. Households where the person in charge of financial matters guessed correctly (and only appeared to be financially competent) are more likely to be financially vulnerable in column 4 than in column 5, where the regression controls for guessing. The standard financial literacy indicator in column 5 has a coefficient similar to the one attracted in column 6 by the indicator that classifies as literate only respondents who consistently appear competent in two consecutive years.

Some of the controls included in Table 5 deserve to be discussed briefly. Regardless of which indicator is the dependent variable, financial fragility is less likely for households with higher income and wealth (as measured by home ownership), more likely for households that include invalids. The estimated coefficients are broadly similar across regressions that include different financial literacy indicators, but those in the first three columns of Table 5 are somewhat different from those in the last three columns. This may indicate that the looser and more stringent definition capture different outcomes, but also that misclassification errors in the left-hand measure of financial fragility are plausibly correlated with observable characteristics as well as with the errors introduced in financial literacy indicators by guessing propensities.

In particular, the gender dummy is significant only as an explanatory variable of the looser and arguably noisier definition of financial fragility, where the gender of the respondent may matter to the distinction between a “probably could” and a “probably could not” subjective assessment. When questions on financial outcomes include very similar answers and may elicit noise responses, assessment of gender differences does appear to depend on wording, as well as on the previously detected role of multiple-choice structures (Baldiga, 2014) and different conceptual frames (Boggio et al., 2020).

7. Concluding comments

This paper models a source of measurement error in answering survey questions identifying competence due to the behavior of respondents who find it difficult to admit their ignorance and who prefer guessing instead of answering they do not know. We detect large propensities to guess in data from two consecutive waves of a survey on financial literacy and resilience of Italian households. We also document that guessing behavior is relevant to personal finance management: in regressions that control for observable individual socio-economic characteristics and account for misclassification, truly literate respondents are more likely than those who guessed and randomly picked the correct answers to make ends meet at the end of the month and to cope with unexpected expenses.

The estimated propensity to guess is higher when questions are perceived to be easier. It also differs across demographic groups. In particular, females are less inclined to guess than males, who more often answer incorrectly the most difficult risk diversification question. Better educated respondents are more competent but have also a higher propensity to guess rather than admitting ignorance. Differences are even larger when comparing respondents with high and low self-assessed personal financial competence.

To the extent that these relationships between observable characteristics, survey responses, and propensity to guess are similar in other survey samples, the attenuation bias introduced by the resulting measurement error should be more or less important for different questions and different subsample. The data-generating mechanism we propose can therefore offer useful guidance to researchers who analyze a single-wave data set: even though it is not possible to correct measurement errors by exploiting repeated answers, it remains possible to interpret correctly the more or less frequent incorrect answers given by observably different respondents to questions for which a DK answer can be an honest admission of ignorance.

Our empirical results offer useful information for survey design. They indicate that a DK option should be included and analyzed carefully in financial literacy surveys, where it is not as easily attributable to laziness or confusion as in surveys of opinions or preferences. They also suggest that designing repeated surveys offers important

opportunities to improve the reliability of financial literacy indicators, and is arguably as important as asking better focused or more numerous questions. We also show that small changes in the wording of questions used to measure financial fragility can introduce misclassification errors in the left-hand variable that are plausibly correlated with observable characteristics as well as with the measurement errors in financial literacy indicators due to guessing behavior.

This paper's empirical and theoretical models can be expanded in a variety of directions. Future research could assess the relevance of guessing for different indicators of financial education or for more general indicators of competence on a topic. It would also be interesting to consider the possibility that wrong answers may be given by respondents who think they know the right answer but make mistakes, as well as to model structurally how reliable indicators of financial literacy may proxy for unobservable individual features that determine financial behavior and outcomes.

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Figure 1. Financial literacy: percentage of households providing correct answers (on all the Big Three questions) in 2020 and in both 2020 and 2021 across demographics and self-assessed financial competence.

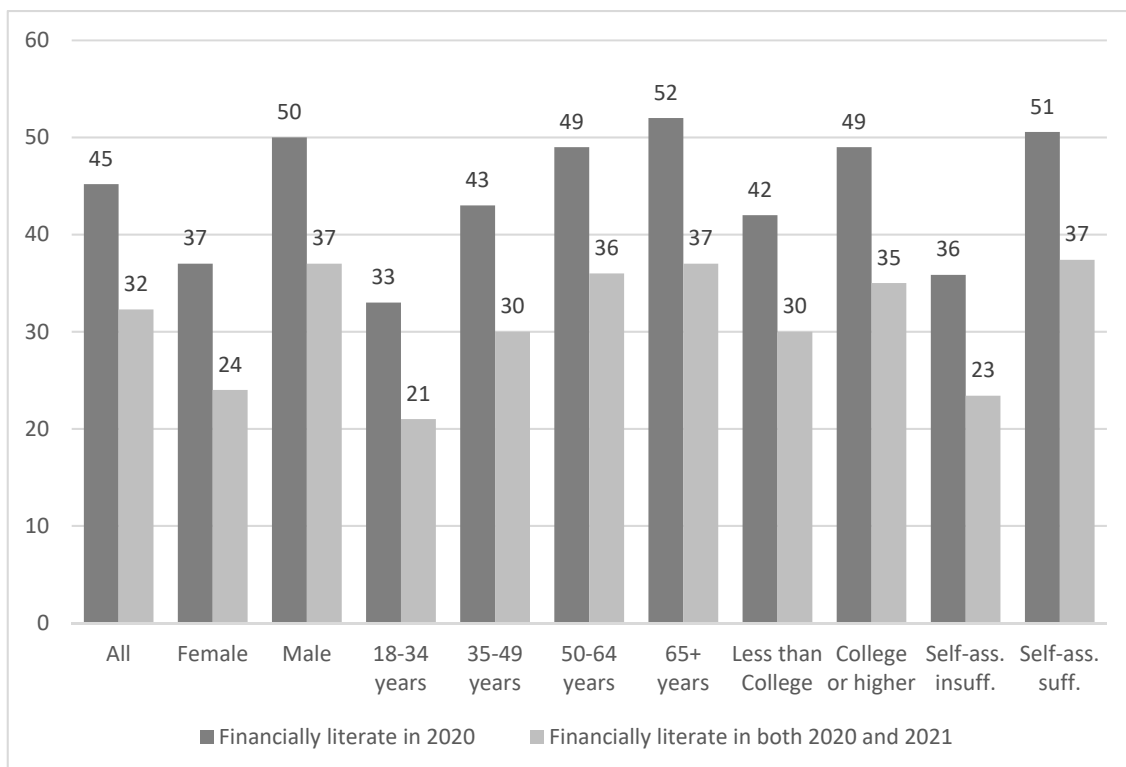


Table 1. Percentage of households providing correct, “Don’t know”, incorrect and correct in 2020 but incorrect in 2021 answers to the Big Three financial literacy questions.

Panel A. Interest rate (numeracy)											
	All	Female	Male	18-34 years	35-49 years	50-64 years	65+ years	Less than College	College or higher	Self- assessed insufficient	Self- assessed sufficient
Correct in 2020	73.9	67.8	77.3	66.6	72.6	76.7	74.9	72.4	75.7	69.3	76.5
Do not know in 2020	6.9	9.4	5.5	8.4	7.7	5.8	6.7	8.1	5.5	11.8	4.1
Incorrect in 2020	19.2	22.7	17.2	25.1	19.7	17.5	18.4	19.5	18.8	18.9	19.4
Correct in 2020 but incorrect in 2021	12.3	14.4	11.0	15.0	13.0	11.1	11.3	13.2	11.1	14.5	11.0
Panel B. Inflation											
	All	Female	Male	18-34 years	35-49 years	50-64 years	65+ years	Less than College	College or higher	Self- assessed insufficient	Self- assessed sufficient
Correct in 2020	70.0	62.0	74.6	50.7	66.2	76.0	79.2	68.1	72.4	63.4	73.8
Do not know in 2020	12.4	17.6	9.4	18.7	14.8	9.8	7.1	13.9	10.4	20.8	7.5
Incorrect in 2020	17.6	20.4	16.0	30.6	19.0	14.2	13.6	18.0	17.2	15.7	18.7
Correct in 2020 but incorrect in 2021	11.9	14.6	10.3	14.7	13.1	10.9	8.7	11.9	11.9	12.6	11.5
Panel C. Risk diversification											
	All	Female	Male	18-34 years	35-49 years	50-64 years	65+ years	Less than College	College or higher	Self- assessed insufficient	Self- assessed sufficient
Correct in 2020	64.9	60.8	67.3	59.9	64.6	66.0	66.4	62.3	68.2	55.3	70.4
Do not know in 2020	21.3	27.5	17.7	23.9	22.0	20.6	18.6	24.2	17.5	32.4	14.9
Incorrect in 2020	13.8	11.7	15.0	16.1	13.4	13.4	15.0	13.5	14.3	12.3	14.7
Correct in 2020 but incorrect in 2021	13.8	14.9	13.2	13.8	13.5	13.9	14.4	13.4	14.3	14.2	13.6

Table 2. Estimated probability to know (\hat{p}) and propensity to guess (\hat{q}).

Panel A. Interest rate (numeracy)											
	All	Female	Male	18-34 years	35-49 years	50-64 years	65+ years	Less than College	College or higher	Self- assessed insufficient	Self- assessed sufficient
\hat{p}	64.2	56.5	68.7	54.0	62.8	68.0	65.7	62.7	66.3	59.9	66.8
\hat{q}	80.6	78.3	82.5	81.8	79.4	82.0	80.4	78.4	83.8	70.7	87.5
Panel B. Inflation											
	All	Female	Male	18-34 years	35-49 years	50-64 years	65+ years	Less than College	College or higher	Self- assessed insufficient	Self- assessed sufficient
\hat{p}	61.2	51.8	66.6	35.4	56.7	69.0	72.4	59.1	63.8	55.6	64.4
\hat{q}	68.1	63.5	71.8	71.0	65.9	68.4	74.2	65.9	71.2	53.1	78.8
Panel C. Risk diversification											
	All	Female	Male	18-34 years	35-49 years	50-64 years	65+ years	Less than College	College or higher	Self- assessed insufficient	Self- assessed sufficient
\hat{p}	51.1	49.0	52.3	43.8	51.2	52.6	51.4	48.8	53.9	43.0	55.7
\hat{q}	56.5	46.1	63.0	57.4	54.9	56.5	61.8	52.7	61.9	43.2	66.4

Note. The table reports percentage values.

Table 3. Empirical analysis.

Dependent variable: Difficulty to make ends meet			
	(1)	(2)	(3)
Correct on all Big Three in 2020	-0.07*** (-2.78)	-0.10*** (-3.37)	
Guessed at least one in 2020		0.09** (2.20)	
Correct on all Big Three in 2020 and 2021			-0.10*** (-3.41)
<i>Gender (ref.: male)</i>			
Female	-0.00 (-0.15)	-0.01 (-0.27)	-0.01 (-0.26)
<i>Age (ref.: 35-49 years)</i>			
18-34 years	-0.04 (-0.88)	-0.04 (-0.95)	-0.04 (-0.95)
50-64 years	0.13*** (4.32)	0.13*** (4.31)	0.13*** (4.31)
65+ years	0.05 (1.22)	0.05 (1.18)	0.05 (1.17)
<i>Education (ref.: less than high school)</i>			
High school degree	-0.05 (-1.56)	-0.04 (-1.50)	-0.04 (-1.50)
College Degree	-0.13*** (-3.89)	-0.13*** (-3.89)	-0.13*** (-3.90)
Post-graduate Degree	-0.11** (-2.57)	-0.11** (-2.49)	-0.11** (-2.49)
Income level	-0.17*** (-12.18)	-0.17*** (-11.95)	-0.17*** (-11.97)
Home ownership	-0.11*** (-4.48)	-0.11*** (-4.44)	-0.11*** (-4.45)
Minors in the household	0.11*** (3.92)	0.10*** (3.79)	0.10*** (3.79)
Invalids in the household	0.09*** (2.74)	0.09*** (2.78)	0.09*** (2.78)
<i>Area (ref.: North-West)</i>			
North-East	0.05 (1.21)	0.05 (1.21)	0.05 (1.19)
Centre	0.05 (1.41)	0.05 (1.41)	0.05 (1.41)
South and Islands	0.11*** (3.29)	0.10*** (3.21)	0.10*** (3.22)
Observations	4027	4027	4027

Note. The table reports OLS estimates. In all columns, the dependent variable is a dummy taking value 1 if the respondents answered the income of their family cover expenses until the end of the month with great difficulty, with difficulty, with some difficulty; zero otherwise. All specifications use sample weights and include a constant (not reported). T-statistics are in parentheses. Significant at * 10 percent, ** 5 percent, *** 1 percent with robust standard errors.

Table 4. Alternative methods to correct measurement errors.

Dependent variable: Difficulty to make ends meet				
	(1a)	(1b)	(2)	(3)
Principal component on 3 dummy variables (correct answers to each of the Big Three)	-0.04** (-2.48)			
Principal component on 6 dummy variables (correct and incorrect answers to each of the Big Three)		-0.03** (-2.15)		
Correct on all six questions in 2020			-0.08** (-2.54)	
Correct on all Big Three in 2020 instrumented by Lewbel heteroskedasticity-based variables				-0.13** (-2.31)
<i>Gender (ref.: male)</i>				
Female	-0.01 (-0.23)	-0.00 (-0.16)	-0.00 (-0.13)	-0.01 (-0.32)
<i>Age (ref.: 35-49 years)</i>				
18-34 years	-0.04 (-0.91)	-0.04 (-0.94)	-0.04 (-0.86)	-0.04 (-0.95)
50-64 years	0.13*** (4.45)	0.13*** (4.41)	0.13*** (4.45)	0.13*** (4.29)
65+ years	0.05 (1.23)	0.05 (1.21)	0.05 (1.17)	0.05 (1.21)
<i>Education (ref.: less than high school)</i>				
High school degree	-0.04 (-1.41)	-0.04 (-1.48)	-0.05 (-1.53)	-0.04 (-1.43)
College Degree	-0.12*** (-3.76)	-0.12*** (-3.84)	-0.13*** (-3.89)	-0.12*** (-3.77)
Post-graduate Degree	-0.11** (-2.41)	-0.11** (-2.50)	-0.11** (-2.54)	-0.11** (-2.48)
Income level	-0.17*** (-12.32)	-0.17*** (-12.35)	-0.17*** (-12.00)	-0.17*** (-11.34)
Home ownership	-0.11*** (-4.51)	-0.11*** (-4.56)	-0.12*** (-4.65)	-0.11*** (-4.39)
Minors in the HH	0.10*** (3.93)	0.10*** (3.87)	0.11*** (3.97)	0.10*** (3.76)
Invalids in the HH	0.08*** (2.65)	0.08*** (2.63)	0.09*** (2.71)	0.08*** (2.65)
<i>Area (ref.: North-West)</i>				
North-East	0.05 (1.26)	0.05 (1.20)	0.04 (1.14)	0.05 (1.33)
Centre	0.05 (1.46)	0.05 (1.45)	0.06 (1.54)	0.05 (1.47)
South and Islands	0.11*** (3.37)	0.11*** (3.39)	0.11*** (3.45)	0.10*** (3.18)
Hansen $\chi^2(13)$ p-value				0.37
Observations	4027	4027	4027	4027

Note. The table reports OLS estimates in columns 1 and 2, 2SLS estimates in column 3. In all columns, the dependent variable is a dummy taking value 1 if the respondents answered the income of their family cover expenses until the end of the month with great difficulty, with difficulty, with some difficulty; zero otherwise. All specifications use sample weights and include a constant (not reported). T-statistics are in parentheses. Significant at * 10 percent, ** 5 percent, *** 1 percent with robust standard errors.

Table 5. Measurement errors and wording: empirical analysis of alternative definitions of financial fragility.

Dependent variable: Financial fragility						
	Looser definition			More stringent definition		
	(1)	(2)	(3)	(4)	(5)	(6)
Correct on all Big Three in 2020	-0.13*** (-5.22)	-0.15*** (-5.47)		-0.14*** (-5.17)	-0.18*** (-5.71)	
Guessed		0.06 (1.64)			0.13*** (2.96)	
Correct on all Big Three in 2020 and 2021			-0.13*** (-5.09)			-0.17*** (-5.56)
<i>Gender (ref.: male)</i>						
Female	0.09*** (3.22)	0.08*** (3.15)	0.09*** (3.17)	0.01 (0.44)	0.01 (0.32)	0.01 (0.35)
<i>Age (ref.: 65+)</i>						
Age 18-34	-0.03 (-0.76)	-0.04 (-0.80)	-0.04 (-0.79)	0.05 (1.31)	0.05 (1.23)	0.05 (1.24)
Age 50-64	0.03 (1.02)	0.03 (1.00)	0.03 (1.00)	0.08*** (2.68)	0.08*** (2.66)	0.08*** (2.66)
Age 65+	0.04 (0.94)	0.04 (0.92)	0.04 (0.89)	0.03 (0.70)	0.03 (0.67)	0.03 (0.65)
<i>Education (ref.: less than high school)</i>						
High school degree	-0.06** (-2.15)	-0.06** (-2.12)	-0.06** (-2.14)	-0.01 (-0.42)	-0.01 (-0.36)	-0.01 (-0.38)
College Degree	-0.13*** (-4.28)	-0.13*** (-4.26)	-0.13*** (-4.30)	-0.04 (-1.32)	-0.04 (-1.31)	-0.04 (-1.36)
Post-graduate Degree	-0.04 (-0.98)	-0.04 (-0.93)	-0.04 (-0.93)	0.05 (1.20)	0.06 (1.30)	0.06 (1.30)
Income level	-0.12*** (-9.40)	-0.12*** (-9.29)	-0.12*** (-9.31)	-0.16*** (-12.72)	-0.16*** (-12.36)	-0.16*** (-12.41)
Home ownership	-0.15*** (-5.83)	-0.15*** (-5.83)	-0.15*** (-5.86)	-0.10*** (-3.76)	-0.09*** (-3.73)	-0.09*** (-3.76)
Minors in the HH	-0.00 (-0.11)	-0.01 (-0.23)	-0.01 (-0.27)	0.09*** (3.39)	0.09*** (3.15)	0.08*** (3.13)
Invalids in the HH	0.09*** (2.99)	0.09*** (3.00)	0.10*** (3.07)	0.06* (1.95)	0.06** (1.97)	0.06** (2.02)
<i>Area (ref.: North-West)</i>						
North-East	-0.02 (-0.63)	-0.02 (-0.64)	-0.03 (-0.76)	-0.02 (-0.54)	-0.02 (-0.56)	-0.02 (-0.63)
Centre	-0.01 (-0.27)	-0.01 (-0.28)	-0.01 (-0.34)	0.01 (0.27)	0.01 (0.25)	0.01 (0.22)
South and Islands	0.04 (1.21)	0.03 (1.13)	0.04 (1.15)	0.02 (0.79)	0.02 (0.64)	0.02 (0.65)
Observations	3817	3817	3817	3817	3817	3817

Note. The table reports OLS estimates. In columns 1-3, the dependent variable is a dummy variable taking value 1 if the respondents answered they certainly or probably could not come up with €2,000 if an unexpected need arose within the next month; zero if they certainly or probably could come up with €2,000; those who answered “I do not know” are excluded from the sample. In columns 4-6, the dependent variable is a dummy taking value 1 if the respondents answered they certainly or probably could not or probably could come up with €2,000 if an unexpected need arose within the next month, zero otherwise. All specifications use sample weights and include a constant (not reported). T-statistics are in parentheses. Significant at * 10 percent, ** 5 percent, *** 1 percent with robust standard errors.

Appendix A

1. Translated text of survey questions and answers

Understanding of interest rate (numeracy). “Suppose you had €100 in a savings account that pays an interest rate of 2% per year and has no charges. After 5 years, how much do you think you would have in the account if you left the money to grow?” a) More than €102 b) Exactly €102 c) Less than €102 d) Don’t know.

Understanding of inflation. “Suppose you had €100 in a savings account that pays an interest rate of 1% per year and has no charges. Imagine that the inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?” a) More than today b) Exactly the same c) Less than today d) Don’t know.

Understanding of risk diversification. “Do you think that the following statement is true or false? ‘Investing €1,000 in stocks of a single company usually is less risky than investing €1,000 in stocks of 10 different companies.’” a) True b) False c) Don’t know.

Understanding of mortgage. “A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less.” a) True b) False c) Don’t know.

Understanding of return. “Buying a single company’s stock usually provides a safer return than a stock mutual fund.” a) True b) False c) Don’t know.

Understanding of compounding interest. “Suppose you deposit money for 2 years into a bank account that pays an interest rate of 5% per year and has no charges. The bank:” a) Will pay more money the second year with respect to the first year b) Will pay the same amount in both years c) Don’t know.

Difficulty to make ends meet. “Does the income of your family cover expenses until the end of the month?” a) With great difficulty b) With difficulty c) With some difficulty d) Fairly easily e) Easily f) Very easily.

Financial fragility. “Should an unexpected need arise, how confident are you that you could come up with 2000 euro in the next month:” a) I am certain I could come up with 2000 euro b) I could probably come up with 2000 euro c) I could probably not come up with 2000 euro d) I am certain I could not come up with 2000 euro e) I do not know.

2. Descriptive statistics

Table A1 - Descriptive statistics of the variables used in the empirical analysis.

	Obs.	Mean	Std. Dev.	Min	Max
Panel A. Financial literacy indicators					
Correct on all Big Three in 2020	4027	0.45	0.50	0	1
Guessed	4027	0.13	0.33	0	1
Correct on all Big Three in 2020 and 2021	4027	0.32	0.47	0	1
Correct on all six questions in 2020	4027	0.24	0.42	0	1
Panel B. Dependent variables					
Difficulty to make ends meet	4027	0.57	0.49	0	1
Financial fragility (looser definition)	3817	0.32	0.46	0	1
Financial fragility (more stringent definition)	3817	0.62	0.49	0	1
Panel C. Demographic, education, gender information					
Female	4027	0.35	0.48	0	1
Male (reference category)	4027	0.65	0.48	0	1
Age 18-24	4027	0.07	0.26	0	1
Age 35-49	4027	0.32	0.47	0	1
Age 50-64 (reference category)	4027	0.33	0.47	0	1
Age 65+	4027	0.27	0.45	0	1
Less than high school (reference category)	4027	0.44	0.50	0	1
High school Degree	4027	0.37	0.48	0	1
College Degree	4027	0.16	0.37	0	1
Post-graduate Degree	4027	0.03	0.18	0	1
Panel D. Household's characteristics and area					
Income level	4027	2.00	1.00	0.44	4.5
Home ownership	4027	0.61	0.49	0	1
Minors in the HH	4027	0.28	0.45	0	1
Invalids in the HH	4027	0.18	0.38	0	1
North-West (reference category)	4027	0.27	0.44	0	1
North-East	4027	0.19	0.40	0	1
Centre	4027	0.20	0.40	0	1
South and Islands	4027	0.34	0.47	0	1

Notes: The table reports information on the weighted sample.

3. Principal factors for the Big Three questions

Table A2 - Factor loadings for the Big Three questions.

Financial literacy questions		Factor loadings
Numeracy:	Correct answer=1, zero otherwise	0.5396
Inflation:	Correct answer=1, zero otherwise	0.6168
Risk diversification: Correct answer=1, zero otherwise		0.4847

Notes: See the first section of this appendix for the exact wording of the questions.

Table A3 - Factor loadings when DK is coded differently from wrong answers.

Financial literacy questions		Factor loadings
Numeracy:	Correct answer=1, zero otherwise	0.7877
Numeracy:	Wrong answer=1, zero otherwise	-0.7074
Inflation:	Correct answer=1, zero otherwise	0.7087
Inflation:	Wrong answer=1, zero otherwise	-0.5900
Risk diversification: Correct answer=1, zero otherwise		0.4579
Risk diversification: Wrong answer=1, zero otherwise		-0.2334

Notes: See the first section of this appendix for the exact wording of the questions.