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Financial education, literacy and investment attitudes

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Non-Technical Summary

A large and growing literature documents that a large fraction of the population lacks of the basic skills to make sound financial decisions. This evidence has prompted a number of financial education initiatives around the world. These initiatives often take the form of education programs, but are rarely designed to be evaluated. A first urgent question is whether financial education is actually effective in enhancing the level of financial literacy.

Using an evaluation design, our experiment studies the effect of financial education on financial literacy, investment attitudes and on how individuals perceive their level of financial literacy. To remove the effect of potentially important confounders, we run the same experiment in the field and in the laboratory.

Our evidence shows a non-negligible effect on financial literacy and investment attitude, but an even larger effect on the degree of self-assessed financial literacy in the population of university students. The exercise thus uncovers an interesting pattern: financial education seems to improve more what individuals think to know than what individuals actually know.

The results suggest that, while being able to increase financial literacy, financial education programs can also cause individuals to become more confident in their abilities without actually being more equipped to face financial decisions. Our results imply an important warning on the effectiveness of financial education initiatives. The increase in self-confidence seems to be a necessary by-product of financial education. An extremely polluting by-product, if the increase in self-confidence is not matched by the improvement in actual skills.

Financial education, literacy and investment attitudes*

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Abstract

Based on a sample of university students, we provide field and laboratory evidence that a small scale training intervention has a both statistically and economically significant effect on subjective and objective assessments of financial knowledge. We also show that for a large part of students whose self-assessed financial knowledge has improved we do not find an increase in their actual skills.

Keywords: Financial education, Financial literacy, Planning, Investment attitudes.

JEL classification: D14, G11, I20

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1 Introduction

Households are routinely called to make crucial decisions in the financial domain regarding both the assets and the liabilities side of their portfolios. On the assets front, the arguably most important decision is on how and how much to save for retirement purposes. The switch from defined benefit to defined contribution social security systems shifts the burden of saving decision on individuals. The question arises of whether individuals are well equipped to face these decisions. The same question applies to the liabilities side. The choice of whether, how and how much to borrow to purchase a house have long-term consequences on the households welfare. The 'wrong' mortgage contract can cause households to be unable to repay and ultimately to default.

Most of the available evidence shows that financial illiteracy is widespread and that shrewd financial behaviors are associated to lower levels of financial illiteracy (see for a survey Lusardi and Mitchell 2014). Households appear to make several mistakes in the domain of financial decisions (see Campbell 2006). The low level of market participation (Haliassos and Bertaut 1995), the lack of portfolio diversification (Goetzmann and Kumar 2008), the disposition effects (Odean 1998), the not refinancing fixed-rate mortgages in a low-regime interest rates (Canner et al. 2002). Furthermore, Calvet et al. (2009) construct an index of financial sophistication using Swedish administrative data, providing robust evidence of portfolio management mistakes.[1] Despite the evidence, it remains an open question whether financial literacy has a causal effect on financial decisions.[2] Gale and Levine (2011) review most of the non-experimental evidence and suggest that financial education could improve financial outcomes. Hastings et al. (2013) point out that unobserved factors could upwardly bias the observed relationship between financial education and financial behavior in non experimental research. Fernandes et al. (2014) provide a meta-analysis of 200 works on the topic and find out that non-experimental studies show significantly larger effect sizes than studies of the effects of financial education intervention. They suggest that omitted variables could produce overestimates of the effects. Furthermore, notice that it can actually be shown within a life-cycle model that financial literacy and portfolio choices are jointly determined without this implying

[1] Other studies document missing of profitable opportunities such as under participation in employer match pension plans Choi et al. (2011) or choices of life insurance Agarwal et al. (2009).

[2] See for a survey Hastings et al. (2013).

a causal effect of the former on the latter (see Jappelli and Padula 2013).

Whatever the causal interpretation of the association between financial literacy and behavior, the lack of awareness of basic financial concepts has called for financial education programs. These programs aim at equipping household investors with the knowledge of a basic set of financial notions and at protecting them through the implementation of appropriate regulations.[3] However, policy makers need a clear picture of the benefits and the costs of promoting financial education program, with exhaustive measures of welfare changes, to compare outcomes from different interventions and to allocate resources. The fundamental question is whether (and how) financial education programs reduce financial illiteracy and accordingly improve financial outcomes.

The literature provides little evidence on the effects of financial education programs. Most of the available financial education programs are in fact targeted to specific population groups and few are designed to be evaluated. Examples of these programs are financial education for school students (see Bruhn et al. 2012 for Brazil and Romagnoli and Trifilidis 2013 for Italy); financial education at the work place (see Bernheim and Garrett 2003, Clark and d'Ambrosio 2008 and Clark et al. 2012a,b); financial education for financial distressed households (Collins and O'Rourke 2010).

Two studies on high-school students represent an exception to the general trend and use the experimental identification strategy to assess the effect of financial education programs. Becchetti et al. (2013) did not find a statistically significant effect of the treatment on financial literacy, while they claim a positive effect on hypothetical behaviors. However, a follow up study (Becchetti and Pisani 2012) points out that students could learn from repeating similar surveys. Lührmann et al. (2012) get rid of the "survey" effect and find out a positive effect of the short training sessions on financial attitudes such as interest in financial matters and saving propensity.

Our paper contributes to the debate by investigating the effect of a small-scale course in basic financial concepts among college students on financial literacy and investment attitudes.[4] On the one hand, we will assess whether the small course in financial education

[3]The Dodd-Frank Act of 2010 established a new consumer protection agency. The OECD and its International Network on Financial Education (INFE) develop tools to support policy makers and public authorities to design and implement national strategies for financial education.

[4]Previous works on financial education for young adult show little evidence with respect to financial literacy. The intervention takes the format of lectures where basic concepts about financial topics are explained to the students. In US, Mandell (2008) evaluates the effects on financial knowledge of high

has a positive impact on subjective and objective assessments of financial knowledge. On the other hand, we will show the correlation between the variations in subjective and objective assessments in order to evaluate to what extent improvements in the self-assessed financial knowledge match actual improvements in the familiarity with financial concepts.

The experimental subjects are students of a medium-scale University, located in the Northeastern part of Italy. The University counts just around 24,000 students, who are enrolled at one of the several BA, MA or PhD courses active in the following four areas: foreign languages, humanities, social sciences, and sciences. The population of interest is made of 24,737 students who are enrolled in the academic years 2012-2014 and is obtained adding to the students enrolled in the academic year 2013/2014 those who graduated in the academic year 2012/2013.

University students are an admittedly special population, but there are several advantages from focusing on them. First, all university students have completed the high-school education, are all equipped with the basic numerical notions needed to understand and to make proper use of financial concepts, such as interest compounding, inflation and risk diversification. This guarantees that they are fully endowed with the mathematical prerequisites required by standard financial education programs. Second, Italian university students mostly have no or very limited job market experience, live with their parents, rely on their parents' income to support their studies, some rely on scholarship and grants, while the market for loans to students is virtually non-existent. Consequently, Italian university students have very little exposure to the financial notions needed to manage savings or debts, and often lack of the basic budgeting notions needed to run a household. These characteristics make the exposure to a short course in financial education more likely to have a sizeable impact on their financial skills. Finally, university students are a rather homogeneous population along some relevant dimensions, such as age, year of birth but also in terms of place of residence, since universities in Italy tend to be local and the geographical mobility of students is limited.

To evaluate the effect of the course, we conduct an experiment. To avoid a heterogeneous provision of the treatment, we use a graphical interface, equal for all the participants. We adopt the standard treatment and control identification structure. The

school students. Cole et al. (2014) report no direct effect of mandatory education on financial attitudes, exploiting cross-state variations.

treatment group receive a short course on basic financial concepts, the control an arguably orthogonal course on the history of Venetian lagoon. Furthermore, we perform the same experiment both through the field and in the laboratory.

We provide three substantive findings, which are consistent between the web and the laboratory experiment. First, the results show a positive effect of financial education on financial literacy. After the course, treated students appear to be more aware of basic financial concepts, such as interest compounding, inflation and diversification, compared to control students. Second, the short course has a positive effect on investment attitudes. The third result relates to the effect on the self-assessed financial literacy. The short course increases the level of self-assessed financial literacy, but, interestingly enough, the increase is larger than the increase in actual knowledge.

The rest of the paper is organized as follows. Section 2 lies down the identification strategy. The data are described in Section 3, while Sections 4 and 5 provide the results. Conclusions are drawn in Section 6.

2 Identification of the effects of financial education

To identify the effect of training on financial literacy and investment attitudes, we exploit the standard randomized trial treatment and control groups structure. We randomly assign individuals to either the treatment or the control group. Individuals in the treatment group listen to a short course on basic economic concepts, such as interest compounding, inflation and risk diversification. The course lasts for about 20 minutes and is provided by a male teacher who accompanies his voice with slides. The course covers three topics: interest compounding, inflation and risk diversification at a basic level. The three topics are presented with the help of simple numerical examples and, whenever relevant, with graphs.[5] The control group instead listens to a course on the history of the Venetian lagoon. As for the treatment group, the course lasts for about 20 minutes and is given by a male teacher. We describe the course material in more details in Appendix A.

As part of the intervention, we ask a battery of questions on financial literacy and investment attitudes just before and immediately after the course to both the treatment

[5]We translate the slides of the course in English and make them available on-line, see http://www.pettinicchi.eu/slsc.pdf.

and the control group. The average time to complete the questionnaire and to watch the video is 45 minutes. The questions elicit the knowledge of basic financial concepts and the ability of individuals to utilize these concepts. The financial literacy questions pertain the content of the course, namely interest compounding, inflation, and risk diversification. The investment attitude questions refer to hypothetical situations in which one should make use of the notions of interest compounding, inflation, and risk diversification. The questions are engineered in such a way that the appropriate usage of the notions interest compounding, inflation, and risk diversification delivers the correct answer. The exact wording of the questions is reported in Appendix B.

We do not ask exactly the same questions before and after the treatment to remove the effect of re-taking a test in a short span of time. The answers to the questions are however fully comparable and should the question require (simple) numerical calculations we make sure that the same calculations are not involved in the before and after the course questions.

Finally, to control for the presence of heterogeneity in the treatment effect, we merge the data obtained from the intervention with selected data from the University administrative archives. The data contain information on the gender of the students as well as their track and their area of study.

To give the students the incentives to participate and to provide the best possible answers, we design a lottery awarding three last generation laptop computers. For each correct answer, our experimental subjects gain a ticket for the lottery.[6] Participants do not receive any feedback about their performance and they are informed about the number of lottery tickets gained only when the data-collection is closed.

We administer the intervention in two ways: in the field and in the laboratory using the same internet platform obtained with LimeSurvey.[7] On our internet platform, each question appears on a separate page, and the respondents are not allowed to proceed if they do not provide an answer.

As anticipated in the introduction, we administer the same experiment both in the

[6]The participation to the experiment is not compulsory. We provide adequate promotion through the student community using institutional media (University website and newsletters, brochures in public space) and informal networks (direct mailing, Facebook, students' radio station) before and during the experiment.

[7]LimeSurvey is an open source application to develop on-line surveys. For further details, see http://www.limesurvey.org/en/.

field and in the laboratory. In the field experiment, the subjects receives an e-mail, which directs them to the platform where the survey and the course are located. The subjects have a month to start the experiment that has to be completed in one shot.

Although the intervention was standardized by the use of the graphical interface, we could not have any control on the conditions in which participation took place in the field case. To overcome this limitation, we replicated the experiment in the laboratory in order to administer it under the conditions that we deem as ideal. Participants operate on the computers individually and listen to the courses through headphones. We make sure that the subjects do not communicate between them and use visual separators between computers. Finally, they could not make use of manuals, textbooks or browsing the web to get hints for answering the battery of questions posed by the interventions.

Next, we describe the measurement of financial literacy and investment attitudes and provide some descriptive statistics.

3 Measuring financial literacy and investment attitudes

We ask three questions to assess the actual financial literacy of participants, three questions to assess their attitudes to investment and one question to assess how they rate their financial literacy.

To capture a standard measure of actual financial literacy, we ask the "Big Three" questions, commonly used in the literature. These questions will be labelled as "Inflation", "Interest compounding" and "Diversification" to emphasize the notions they are meant to elicit.

The investment attitudes questions put students in hypothetical situations in which they are given a set of alternatives to select. Only one of the available answers is correct. Students should make use of the same set of notions elicited by the "Big Three" questions to find out the correct answer. In the "Real vs. Nominal" question, finding the correct answer requires to calculate the yearly return of a financial asset net of inflation. In the "Investment plan" question, the notion of interest compounding is needed to compare correctly the returns of two investments. In the "Rule of 72" question, participants are asked to assess the doubling time of a loan.

The outcomes of interest for the financial literacy and investment attitude domains include the probability of answering correctly to each single question as well as the overall number of correct answers by domain.

In addition, one question is devoted to measure the self-assessed financial literacy of respondents according to a numerical scale spanning from 1 to 7, with 1 being the lowest and 7 the highest level.

All these questions are posed before and after the intervention takes place and regardless of being assigned to the treatment or control group. The next section provides descriptive statistics for all the outcomes of interest collected by the field and the laboratory experiment. The participants are university students with presumably good cognitive abilities. Therefore, we expect higher initial level of financial literacy than what it is generally reported for the Italian population (see Fornero and Monticone 2011).

Table 1 shows selected descriptive statistics for the population of interest and for the samples of students who completed the field and the laboratory experiment. The population of interest consists of 24,747 students enrolled in the academic years 2012-14. Females are 65% of the population. Economics is the area of study for 36% of the students, languages for 35%, humanities for 21% and science for 8%. Most of the participants are bachelor students (71%), master students amount to 25% of the sample, PhD students only to 4%. Overall, the samples of students who completed the field and the laboratory experiment consist of 579 and 100 individuals respectively. The sample size for the laboratory experiment is much smaller than the one for the field experiment due to space and resource constraints. These two samples of students will be used in all the following analyses. In both cases, the sample distributions of gender and track of study align well with their population counterparts. The sample of the laboratory experiment participants is characterized by an overrepresentation of the students of economics to the detriment of those in humanities.[8]

3.1 Descriptive statistics: field experiment

Table 2 reports the sample averages of all the outcomes of interest collected both before and after the intervention takes place for the treated and the control groups. Within

[8]Appendix C discusses the results of a battery of robustness checks to control for unit nonresponse.

the sample of participants who completed the experiment, 321 have been assigned to the treated group and 258 to the control group.

Table 2 shows that before the intervention the differences in the average outcomes between treated and control groups are negligible. They widen after the intervention takes place. The probability of answering correctly to the questions in the objective financial literacy and investment attitudes domains increases over time for the students in the treated group, whereas it remains rather constant for those in the control group. The widest variations are found for the questions on "Interest compounding" and "Investment plan". For the "Interest compounding" question the probability of choosing the correct answer increases by 31% for the treated group and decreases by 1% for the control group. For the "Investment plan" question this probability increases by 11% for the treated group and decreases by 6% for the control group. If we look at the variations in the overall number of correct answers in the financial literacy and investment attitudes domains, we find that in both domains it increases by about 8% for the participants to the short course and decreases for the control group. These comparisons suggest that the short course in financial education can induce a positive shock on the financial literacy and behaviour of participants that would not take place in its absence.

Finally, it is worth noting that the self-assessed financial literacy, which measures the respondents' confidence in their financial education, increases by 25% for the treated group and by 3% for the control group. This descriptive evidence points out that the short course might have an impact on both individuals' actual ability with the tools needed to manage financial portfolios and their self-confidence about their own ability in managing portfolios.

3.2 Descriptive statistics: laboratory experiment

Table 3 reports the sample averages for the outcome of interest collected for the participants in the laboratory experiment. All the 100 participants completed the experiment, 52 of them have been randomly assigned to the treated group and 48 to the control group.

The short course in financial education produced a positive shock on participants' skills. Those who attend the short course become 14% more likely to answer correctly to the "Inflation" question, whereas for those who were assigned to the control group

this variation is equal to 5%. If we look at the results for the "Interest compounding" question, we notice that the probability of answering correctly increases by 28% for the treated group and decreases by 4% for the control group. Analogous variations are found for all the investment attitudes questions. With the exception of the "Diversification" question, the improvement in the likelihood of answering correctly after the intervention is remarkably higher for the treated group than for the control group.

The same pattern applies to the self-assessed financial literacy, which increases by 23% for the treated group and by just 3% for the control group. Overall, the evidence in Table 3 suggests that the intervention brought about a positive shock on the participants' actual and self-assessed financial skills.

4 Evidence from the field

4.1 The effect of the short course financial education

Our econometric analysis is designed to assess the effect of the short course in financial education on actual financial literacy, investment attitudes and self-assessed financial literacy. The experimental design of our intervention assigns participants to the treated and the control group by randomization. This makes it possible to assess the effect of the short course by comparing the variations in the outcomes of interest before and after the intervention takes place between the treatment and the control groups. For each outcome of interest, we run a standard OLS regression of its variation before and after the intervention on a constant term and a treatment dummy T assigning value 1 to the participants in the treated group and 0 to those in the control group. The coefficient on the treatment dummy is the difference-in-difference estimator of the causal effect of the short course in financial education.[9]

Table 4 shows the results for financial literacy, Table 5 for investment attitudes. Columns 2 to 4 of Table 4 refer to the "Inflation", the "Interest compounding" and the "Diversification" questions, column 5 to the number of correct answers to these questions. Table 5 is similarly constructed, with columns 2 to 4 referring to "Real vs. Nominal",

[9]We could estimate the same effect by calculating the difference in the outcomes of interest after the intervention between the treated and the control group. We prefer the difference-in-difference estimator since it allows controlling for individual fixed effects that might have a role in unit nonresponse, as discussed in Appendix C.

the "Investment plan", and the "Rule of 72" questions, and column 5 to the number of correct answers.

In column 2 to 4 of Table 4 the dependent variables are dummies that can take three values, -1, 0, 1 depending on whether the answer was correct before and incorrect after the course, has not changed after the course and is incorrect before and correct after the course. In column 5 the dependent variable is defined as the difference in the overall number of correct answers given before and after the intervention. The dependent variables in Table 5 are constructed in the same way.

The evidence from Table 4 shows a significant impact of the treatment on the overall number of correct answers. On average, attending the short course increases the overall performance in this domain by 0.23. Indeed, for those who attend the short course the overall number of correct answers increases by 0.21, for those assigned to the control group it decreases by 0.02. This variation is not negligible even in qualitative terms since the average number of correct answers in this domain is around 2.3 before the intervention takes place. Then, the short course attendance increases by about 10% the overall performance. The effect is mostly due to the increased awareness of the notions of inflation (5%) and interest compounding (18%), while the effect on diversification is negligible.

Turning to the results for the investment attitudes, Table 5 shows that the number of correct answers increases by 0.23, mostly due to the effect on the "Investment plan" and the "Rule of 72" questions, both requiring the students to make use of the notion of interest compounding. Again, the effect is sizeable since it amounts to about 12% of the average pre-intervention levels.

Finally, we also compute the difference in the degree of self-assessed financial literacy before and after the intervention. Because of the treatment, score increases by 0.761 (standard error 0.080), an effect both statistically and economically significant. Since the before intervention average score is 3.44, the intervention means that self-assessed knowledge increases by more than 20%. Below, we investigate whether such an increase corresponds to an increase in actual knowledge.

Students are a homogeneous population in many respects. All students are high school graduates and most of them are aged between 18 and 25. Most students come from similar

socio-economic backgrounds and virtually the same geographical area. However, there are various sources of heterogeneity that can be relevant for assessing the effect of financial education. We investigate differences in gender, field of study, and level of education.

The literature has recently emphasized the gender differences in financial literacy and behaviour.[10] Therefore, in Table 6 we estimates the effect of financial education on the number of correct answers to the financial literacy (columns 2 and 3) and investment attitudes (columns 4 and 5) questions by gender. The results show a significant effect for both males and females. The effect is statistically and economically significant and similar between males and females. The differences between genders are instead more pronounced for the effect of financial education on self-assessed financial literacy. The effect for females is 0.803 (s.e. 0.108), for males 0.703 (s.e. 0.119).

The field of study is another potentially relevant dimension of heterogeneity. We therefore distinguish the effect of financial education between economics, humanities, languages and sciences. The results are reported in Table 7, where the top panel focuses on financial literacy and the bottom on investment attitudes. The effect on financial literacy is positive for all fields of studies, larger for languages and science, and smaller for economics. The pattern for the effect on investment attitudes is less clear. The effect is not statistically significant for humanities and sciences, but is similar for economics and languages. We also investigate whether there are differences between fields of studies for the effect on self-assessed financial literacy. The results, reported in Table 8, confirm a sizable and significant effect of the course on self-assessed financial literacy on all fields of studies. The effect is similar between fields of studies, but larger for sciences and humanities, and smaller for economics and languages. Interestingly, the effect of the course on actual knowledge is more pronounced for the economics and languages students, and less for students belonging to the other fields of study.

A further dimension of heterogeneity is the level of education. The population of interest is made of undergraduate and graduate students. Table 9 reports the results and shows that for financial literacy (columns 2 and 3) the effect is mostly concentrated among undergraduate students, while for the investment attitudes the effect is similar between undergraduate and graduate students. Finally, we explore the differences on self-

[10]For a review, see Hung and Brown (2012).

assessed financial literacy. In Table 10 we split the sample between undergraduate and graduate students and regress changes in the self-assessed financial literacy score on the treatment dummy. The effect is strong for both undergraduate and graduate students.[11] The result contrasts with the effect on actual knowledge, which is much smaller and hardly different from zero for the graduated students. Our evidence points to actual diverging from self-assessed knowledge, an issue that we investigate below.

4.2 Actual versus self-assessed knowledge

Our findings highlight a positive and significant effect of our intervention on both the objective and the self-assessed skills of participants. A natural question to address is whether those who become more confident in their skills are also learning more out of the course. To address the issue, we assess the correlation between the variations in the actual financial skills of students and the variations in their self-confidence. In addition, we also investigate the relation between investment attitudes and self-assessed financial literacy.

Table 11 shows the joint distribution of changes in actual and self-assessed financial literacy, the former being measured with the number of correct answers to the financial literacy question.

Column 2 of Table 11 indicates that 7.6% is the relative frequency with which self-assessed financial knowledge has decreased after the intervention. Of this, 1.9% is the relative frequency with which actual knowledge is also decreased, 4.15% with which actual knowledge has not changed, 1.55% with which actual knowledge has increased. The other columns are similarly interpreted. The degree of correlation between changes in actual and self-assessed knowledge is therefore larger the closer to 100 the numbers on the main diagonal.

About 50% of students lie on the main diagonal. This means that variations in actual skills and variations in self-assessed skills are broadly consistent for half of the sample. However, for about 30% of the sample the improvement in self-assessed financial literacy is not matched by an improvement in actual financial literacy since it remains constant or even gets worse. Therefore, Table 11 points to the limited correlation between actual and

[11] We tested the heterogeneity of the treatment effect on self-assessed financial literacy across genders, areas of study and levels of education. The differences are not statistically significant.

self-assessed knowledge. The latter increases in the 41 percent of cases, but only in just below 11 percent of cases actual knowledge also increases, while in 27 percent of cases it remains unchanged after the treatment.

Table 12 investigates the correlation between changes in investment attitudes and changes in self-assessed financial literacy. The pattern of results is similar to that of Table 11. The correlation between investment attitudes and self-assessed financial literacy is positive, but well below 1. Investment attitudes improve for less than 1/3 of those whose self-assessed financial literacy increases.

The same pattern arises if we regress changes in self-assessed financial literacy on the treatment dummy and changes in the total number of correct answers in the financial literacy domain (or, alternatively, its analogue for the investment attitude domain). Table 13 shows that the intervention has always a significant and positive effect even controlling for variations in actual financial literacy (column 2) and investment attitudes (column 3). This further piece of evidence suggests that considering improvements in self-assessments as actual improvements in actual skills can be misleading and that the impact of the short course in financial education on financial literacy self-assessments is not entirely driven by an actual improvement in the skills individuals need to manage financial portfolios effectively.

5 Evidence from the laboratory

We now analyze the results obtained from the laboratory experiment. Variable definition and estimation strategy are the same used in the field experiment case. Table 14 reports the results for the financial literacy domain. Attending the course increases the overall number of correct answers by 0.23. This effect is extremely close to its analogue found for the field experiment even if we look at its implications in terms of percentage variation in the overall performance, which is around 10%. This variation is driven by the improved performance in the "Interest compounding" question. The probability of answering correctly to this question increases by 0.21 percentage points due to the course attendance.

Table 15 shows the effect of our intervention on investment attitudes. The effect on the overall performance is higher than in the field case. On average, attending the

course induces an increase in the overall number of correct answers by 0.47. This implies on average an increase of 24% in the outcome of interest. The variation in the overall performance is driven by the effect on the "Real vs Nominal" and "Investment plan" questions.

Likewise, in the field case, our intervention keeps on producing a positive and significant effect on the self-assessed financial literacy, which increases on average by 0.70 points. Again, the magnitude of this variation is remarkably similar to its counterpart in the field case and amounts to 20% of the average pre-intervention level.

In the remainder of this section, we want to assess whether there is a mismatch between the variations in the self-assessed and actual knowledge of financial tools. Table 16 reports the joint distributon of actual and self-assessed financial literacy. Its structure is entirely analogous to the one of Table 9. For more than 50% of the sample the variations in actual and self-assessed financial literacy are consistent. However, for almost 70% of the participants declaring their self-assessed financial literacy improved, we observe that their actual financial literacy remained stuck to the pre-intervention levels or even got worse. Overall, whereas actual financial literacy gets better for only 20% of the sample, self-assessments improves for more than 40%. Table 17 reports the joint distribution of actual investment attitudes and self-assessed financial literacy. Results are entirely analogous and denote a clear mismatch between variations in actual and self-assessed skills.

Finally, we regress the variation in financial literacy self-assessments before and after the intervention on the treatment dummy and on the variation in the total number of correct answers in the financial literacy domain. Results are summarized in the column 2 of Table 18. The treatment dummy remains a strong predictor of self-assessment changes even after controlling for the variation in the actual performance. Everything else constant, those who attend the course improve their self-assessed financial literacy by 0.66 points. Conditioning on the variation in the actual financial literacy produces a negligible decrease in the parameter on the treatment dummy (lower than 10%). Analogous results are found when replacing the total number of correct answers in the financial literacy domain with its counterpart for investment attitudes (see column 3 of Table 18). As in the field case, these findings clearly suggest that the short course in financial education induces an increase in the self-assessed skills that is not entirely explained by the

improvement in the actual skills.

6 Conclusions

A large and growing literature documents that a large fraction of the population lacks of the basic skills to make sound financial decisions. This evidence has prompted a number of financial education initiatives around the world. These initiatives often take the form of education programs, but are rarely designed to be evaluated. A first urgent question is whether financial education is actually effective in enhancing the level of financial literacy.

Using an evaluation design, our experiment studies the effect of financial education on financial literacy, investment attitudes and on how individuals perceive their level of financial literacy. To remove the effect of potentially important confounders, we run the same experiment in the field and in the laboratory. To the best of our knowledge, this is the first paper to follow this approach.

Our evidence shows a non-negligible effect on financial literacy and investment attitude, but an even larger effect on the degree of self-assessed financial literacy in the population of university students. The exercise thus uncovers an interesting pattern. Financial education seems to improve more what individuals think to know than what individuals actually know. The results suggest that, while being able to increase financial literacy, financial education programs can also cause individuals to become more confident in their abilities without actually being more equipped to face financial decisions.

Our results imply an important warning on the effectiveness of financial education initiatives. The increase in self-confidence seems to be a necessary by-product of financial education. An extremely polluting by-product, if the increase in self-confidence is not matched by the improvement in actual skills.

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Tables

Table 1: Population and Sample Frequencies

%	Population	Field experiment	Laboratory experiment
Gender			
Males	34.92	42.66	44.00
Females	65.08	57.34	56.00
Area of study			
Economics	35.97	44.73	61.00
Humanities	20.76	14.16	9.00
Sciences	7.99	9.15	4.00
Languages	35.28	31.95	26.00
Track of study			
BA	70.82	62.00	71.00
MA	25.06	34.89	27.00
PhD	4.12	3.11	2.00
Observations	24,737	579	100

Note: The table reports the distribution of gender, area and track of study in the population and in the sample of students who completed the field and the laboratory experiment.

Table 2: Financial literacy, investment attitudes and self-assessed financial literacy in the field experiment

	Before intervention		After intervention	
	Treated	Control	Treated	Control
Financial literacy				
% of correct answers				
Inflation	0.90	0.90	0.95	0.90
Interest compounding	0.55	0.57	0.72	0.56
Diversification	0.90	0.89	0.88	0.87
Number of correct anwers	2.35	2.35	2.55	2.33
Investment attitudes				
% of correct answers				
Real vs. Nominal	0.53	0.51	0.54	0.50
Investment plan	0.74	0.76	0.83	0.72
Rule of 72	0.62	0.62	0.67	0.59
Number of correct answers	1.89	1.89	2.03	1.81
Self-assessed financial literacy				
Mean score	3.51	3.35	4.38	3.46
Observations	321	258	321	258

Note: The table reports selected statistics on financial literacy, investment attitudes and self-assessed financial literacy before and after the intervention for the control and the treatment group.

Table 3: Financial literacy, investment attitudes and self-assessed financial literacy in the laboratory experiment

	Before intervention		After intervention	
	Treated	Control	Treated	Control
Financial literacy				
Inflation	0.85	0.92	0.96	0.96
Interest compounding	0.69	0.52	0.88	0.50
Diversification	0.98	0.94	0.88	0.90
Number of correct anwers	2.52	2.38	2.73	2.35
Investment attitudes				
Real vs. Nominal	0.48	0.52	0.62	0.48
Investment plan	0.85	0.90	0.98	0.85
Rule of 72	0.69	0.56	0.75	0.50
Number of correct anwers	2.02	1.98	2.35	1.83
Self-assessed financial literacy				
Mean score	3.56	3.56	4.37	3.67
Observations	52	48	52	48

Note: The table reports selected statistics on financial literacy, investment attitudes and self-assessed financial literacy before and after the intervention for the control and the treatment group.

Table 4: Financial literacy

	Inflation	Interest compounding	Diversification	Number of correct answers
T	0.046*	0.176***	0.007	0.229***
	(0.027)	(0.032)	(0.028)	(0.052)

Note: The number of observations is 579. The dependent variables in columns 2 to 4 are changes before and after the course in the 0/1 dummies taking value 1 if the answer to the "Inflation" (column 2), "Interest compounding" (column 3), and "Diversification" (column 4) questions are correct. The dependent variable in column 5 is the number of correct answers. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table 5: Investment attitudes

	Real vs. Nominal	Investment Plan	Rule of 72	Number of correct answers
T	0.016	0.131***	0.082**	0.229***
	(0.041)	(0.039)	(0.035)	(0.070)

Note: The number of observations is 579. The dependent variables in columns 2 to 4 are changes before and after the course in 0/1 dummies taking value 1 if the answer to the "Real vs. Nominal" (column 2), "Investment plan" (column 3), and "Rule of 72" (column 4) questions are correct. The dependent variable in column 5 is the number of correct answers. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table 6: Financial education and gender

	Financial Literacy		Investment Attitudes	
	Females	*Males*	*Females*	*Males*
T	0.217***	0.245***	0.207**	0.258**
	(0.072)	(0.075)	(0.096)	(0.100)

Note: The number of observations is 332 in columns 2 and 4, and 247 in columns 3 and 5. The dependent variable in columns 2 to 3 is the number of correct answers in the financial literacy questions, in column 4 to 5 in the investment attitude questions. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table 7: Financial education and field of study

	Economics	*Humanities*	*Languages*	*Sciences*
	Financial literacy			
T	0.161**	0.216	0.330***	0.281*
	(0.067)	(0.168)	(0.106)	(0.168)
	Investment attitudes			
T	0.207**	0.301	0.243*	0.130
	(0.097)	(0.198)	(0.133)	(0.243)

Note: The number of observations is 259 in columns 2, 82 in column 3, 185 in column 4 and 53 in column 5. In the top panel the dependent variable is the number of correct answers in the financial literacy questions, in the bottom in the investment attitude questions. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table 8: Financial education, field of study and self-assessed financial literacy

	Economics	*Humanities*	*Languages*	*Sciences*
T	0.766***	0.826***	0.677***	0.890***
	(0.113)	(0.216)	(0.160)	(0.248)

Note: The number of observations is 259 in columns 2, 82 in column 3, 185 in column 4 and 53 in column 5. The dependent variable is the change in the self-assessed financial literacy score before and after the course. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table 9: Financial education and degree

	Financial Literacy		Investment Attitudes	
	Undergraduate	*Graduate*	*Undergraduate*	*Graduate*
T	0.297***	0.113	0.206**	0.269**
	(0.066)	(0.083)	(0.090)	(0.109)

Note: The number of observations is 359 in columns 2 and 4, and 220 in columns 3 and 5. The dependent variable in columns 2 to 3 is the change in number of correct answers in the financial literacy questions, in column 4 to 5 in the investment attitude questions. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table 10: Financial education, self-assessed financial literacy and degree

	Undergraduate	*Graduate*
T	0.702***	0.855***
	(0.104)	(0.126)

Note: The number of observations is 359 in column 2, and 220 in column 3. The dependent variable is the change in the self-assessed financial literacy score. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table 11: Correlation between actual and self-assessed financial literacy

Changes in actual financial literacy	Changes in self-assessed financial literacy			
	Decrease	Equal	Increase	Total
	%	%	%	%
Decrease	1.90	5.18	3.80	10.88
Equal	4.15	39.03	26.94	70.12
Increase	1.55	6.74	10.71	19.00
Total	7.60	50.95	41.45	100.00

Note: The number of observations is 579. The table shows the estimate of the joint distribution of changes in actual and self-assessed financial literacy.

Table 12: Correlation between investment attitudes and self-assessed financial literacy

Changes in investment attitudes	Changes in self-assessed financial literacy			
	Decrease	Equal	Increase	Total
	%	%	%	%
Decrease	2.07	10.36	7.08	19.52
Equal	3.45	31.61	22.11	57.17
Increase	2.07	8.98	12.26	23.32
Total	7.60	50.95	41.45	100.00

Note: The number of observations is 579. The table shows the estimate of the joint distribution of changes in investment attitudes and self-assessed financial literacy.

Table 13: Financial education, self-assessed financial literacy and actual skills

	Financial literacy	*Investment attitudes*
T	0.724^{***}	0.745^{***}
	(0.083)	(0.081)

Note: The number of observations is 579. The dependent variable is the change in the self-assessed financial literacy score. The specifications in columns 2 and 3 control for the change in actual financial literacy and the change in investment attitudes respectively. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table 14: Financial literacy

	Inflation	Interest compounding	Diversification	Number of correct answers
T	0.074	0.213**	−0.054	0.232*
	(0.060)	(0.096)	(0.065)	(0.129)

Note: The number of observations is 100. The dependent variables in columns 2 to 4 are changes before and after the course in the 0/1 dummies taking value 1 if the answer to the "Inflation" (column 2), "Interest compounding" (column 3), and "Diversification" (column 4) questions are correct. The dependent variable in column 5 is the number of correct answers. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table 15: Investment attitudes

	Real vs. Nominal	Investment Plan	Rule of 72	Number of correct answers
T	0.176*	0.176**	0.120	0.473***
	(0.096)	(0.069)	(0.079)	(0.140)

Note: The number of observations is 100. The dependent variables in columns 2 to 4 are changes before and after the course in 0/1 dummies taking value 1 if the answer to the "Real vs. Nominal" (column 2), "Investment plan" (column 3), and "Rule of 72" (column 4) questions are correct. The dependent variable in column 5 is the number of correct answers. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table 16: Correlation between actual and self-assessed financial literacy

Changes in actual financial literacy	Changes in self-assessed financial literacy			
	Decrease	Equal	Increase	Total
	%	%	%	%
Decrease	4.00	5.00	3.00	12.00
Equal	4.00	38.00	26.00	68.00
Increase	1.00	6.00	13.00	20.00
Total	9.00	49.00	42.00	100.00

Note: The number of observations is 100. The table shows the estimate of the joint distribution of changes in actual and self-assessed financial literacy.

Table 17: Correlation between investment attitudes and self-assessed financial literacy

Changes in investment attitudes	Changes in self-assessed financial literacy			
	Decrease	Equal	Increase	Total
	%	%	%	%
Decrease	2.00	8.00	3.00	13.00
Equal	3.00	35.00	26.00	64.00
Increase	4.00	6.00	13.00	23.00
Total	9.00	49.00	42.00	100.00

Note: The number of observations is 100. The table shows the estimate of the joint distribution of changes in investment attitudes and self-assessed financial literacy.

Table 18: Financial education, self-assessed financial literacy and actual skills

	Financial literacy	*Investment attitudes*
T	0.658^{***}	0.733^{***}
	(0.201)	(0.234)

Note: The number of observations is 100. The dependent variable is the change in the self-assessed financial literacy score. The specifications in columns 2 and 3 control for the change in actual financial literacy and the change in investment attitudes respectively. Estimates are obtained using the OLS method. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Appendix A Course Material

The treatment course and the control course are provided through a series of short videos of one-two minutes length. We decide to split the courses into shorter videos to maximize students' attention. When the student is ready to start the course, then the first video starts automatically and, only when the short video is over, the button to go on is activated. Once the student press the button "next", the following video starts automatically, and so on and so forth. We are able to record the time between the two clicks and to compare it with the actual time of the video.

Fifteen videos compose the course on basic finance, the treatment. The same male teacher discusses the topics that are treated on the full screen slide. There are six main topics that are sequentially treated: the concept of patience, the interest rate, the present and the future value of money, the inflation and the concept of risk. The concept of patience deals with the comparison between present and future needs and it is introduced by the children story "The Cicada and the Ant". Then, the interest rate is used to measure the reward necessary to compensate an impatient person to postpone current consumption. In order to compare cash flows available at different points in time, the future value of money is discussed and the compounding mechanism is introduced. At this point, the student is able to distinguish exponential growth from linear growth of the future value of money. Similarly, the teacher treats the present value of the money and the discounting mechanism. The course also explores the role played by the changes in price level on the purchasing power of a consumer through the time. The last topic of the course is the concept of risk. Using the story of a farmer who faces uncertain outcomes due to the weather and the crop type, a risk diversification strategy is discussed in order to reduce the exposure to bad outcomes.

Twelve videos compose the course on the history of the Venetian lagoon, which is given to the control group. It is arguably orthogonal to the contents of the treatment course given that deals with non-financial issues. The core of the course refers to the changes in the morphological evolution of the lagoon, with a focus on the human facilities (channels, fishing fields, barriers, etc.) that have had an impact on the functioning of the lagoon as an ecosystem. For further details (in Italian) see http://www.youtube.com/watch?v=tIQ8tfgBpCI.

Appendix B Wording of questions

The question about the self-assessed financial literacy is asked at the beginning of the activity. It is also asked with the same wording at the end, after the course and the battery of the questions on financial literacy and investment attitudes.

Self-Assessed Financial Literacy Financial Literacy refers to the set of skills required to understand the opportunities offered by financial markets and invest their savings in a conscious and informed way. On a scale of 1 to 7, with 1 being the lowest and 7 the highest level, how would you rate your overall level of financial literacy?

The battery is composed of six questions: three about the investment attitudes and three about financial literacy. The wording of the former is as the following:

Real vs. Nominal Which of the two scenarios listed below do you prefer?

1 You are dealing with an inflation rate of 1% per year (which costs 100 today, it will cost 101 a year) and you are investing all your savings in a financial asset that will give you a yearly return of 6% in 50% of cases and 2% in the other 50% of cases.

2 You are dealing with an inflation rate of 0% per year (which costs 100 today, it will cost 100 a year) and you are investing all your savings in a financial asset that will give you a yearly return of 5% in 50% of cases and 1% in the other 50% of cases.

3 The two scenarios are equivalent.

99 I do not know / I do not have elements to answer.

Investment plan Compare the two investment plans for a period of two years given below. Which investment plan you prefer?

1 Investing €100 at the rate of 5% for the first year and reinvest the entire amount available at the end of the first year at the rate of 6% for the second year.

2 Investing €100 and after two years getting €111.

3 I am indifferent between the two investment plans.

99 I do not know / I do not have elements to answer.

Rule of 72 Suppose you owe €1000 on your credit card and the interest rate you are charged is 20% per year compounded annually. If you did not pay anything off, at this interest rate, how many years would it take for the amount you owe to double?

1 2 years.

2 Less than 5 years.

3 Between 5 and 10 years.

4 More than 10 years.

99 I do not know / I do not have elements to answer.

To capture a standard measure of financial literacy, we ask the "Big Three" questions, commonly used in the literature. We keep the same wording for the questions asked before and after the course.

Inflation Suppose that you leave €1000 to an account that pays an interest rate of 1% per year and has no running costs. Also assume that inflation is 2% per year. According to you, when in a year you will withdraw your money, you will be able to buy the same amount of goods that you could buy today spending €1000?

1 Yes.

2 No, I will be able to buy a lower amount.

3 No, I will be able to buy a higher amount.

99 I do not know / I do not have elements to answer.

Interest compounding Suppose you had €1000 in a savings account, without running costs, and the interest rate was 2% per year. According to you, after 2 years, how much do you think you would have in the account if you left the money to grow?

1 Less than €1040.

2 Exactly €1040.

3 More than €1040.

99 I do not know / I do not have elements to answer.

Diversification Which of the following investment strategies involves a greater risk of losing money?

1 Invest own savings in the securities of one company.

2 Invest own savings in the securities of several companies.

99 I do not know / I do not have elements to answer.

The battery of six questions is asked before and after the course. To minimize the effect of re-taking the test in a short span of time, we proceed as follows: (i) we change the wording of some questions, (ii) we randomize the order of the questions within the battery and (iii) we randomize the order of the answers. The three questions about investment attitudes, asked after the course, differ in the amounts reported, i.e. we keep the same structure of the question but we double all the amounts involved. We also randomize the order of the six questions so that the student goes through the battery after the course without a clear reference of what he has answered before the course. This procedure allows us to avoid the arising of fixed patterns of answers that could be recalled by the student and could affect the answers. In addition, the procedure should help in reducing the diffusion, through "words-of-mouth", of answers among students who face the incentive to answer correctly and the costs of providing some effort in doing it. To reinforce this last procedure, we randomize also the order of the answers.

Appendix C Unit nonresponse

Table 1 shows that the distributions of gender, area and track of study within the sample of respondents who completed the field experiment align quite well with their population counterparts. However, it can be argued that the individuals willing to complete the experiment might be those more interested in financial education or those more likely to apply the notions of financial literacy in their daily life. Failing to control for unit

nonresponse will prevent us from extending the results obtained within our selected sample to the whole population of interest.

Our identification strategy already addresses unit nonresponse since it develops a difference-in-difference estimator, which by construction controls for all the time invariant characteristics of participants. In addition, when the treatment effect is estimated on specific subsamples defined by gender, area and track of studies, we implicitly allow the effects of the time-invariant characteristics controlled by the difference-in-difference estimator to vary along these dimensions. As long as the decision to complete the experiment is determined by these factors, our identification strategy is suited to take into account the unit nonresponse.

However, to assess the robustness of our results to unit nonresponse, we estimated the effect of our intervention by resorting to a battery of alternative approaches.

First, we estimate the treatment effect by assigning to each participant a weight defined as the inverse of her/his probability of inclusion in the sample. Weights have been defined by estimating the probability of completing the experiment for all the 24,737 students in the population by a standard probit model. The set of explanatory variables used in the probit regression includes age, gender, area, track and year of study, country of residence and region of residence (for Italian students). The participants' probability of being included in the sample is the inverse of their probability of completing the questionnaire. The treatment effect is then estimated via weighted regressions. The effect of financial education on financial literacy and investment attitudes remain sizeable and significant. On average, attending the short course in financial education increases the number of correct answers in the financial literacy and investment attitudes domains by 0.288 (s.e. 0.069) and 0.344 (s.e. 0.096) respectively. The average effect on financial literacy self-assessment is 0.671 (s.e. 0.101).

Second, we make use of the probit regression used to retrieve weights as first step of a formal Heckman procedure in order to account for the sample selection. The probit estimates are used to calculate the inverse Mill's ratio, which is included in the main equation used to estimate the treatment effect. Standard errors have been adjusted to control for the inclusion of a generated regressor. Our findings are again confirmed. On average, the number of correct answers in the financial literacy domain increases by 0.224

(s.e. 0.054) for those who attend the short course of financial education, whereas their number of correct answers for the investment attitudes question increases by 0.234 (s.e. 0.070). The effect of the intervention on financial literacy self-assessment is 0.760 (s.e. 0.084).

Finally, we directly included the set of covariates used in the probit regression to retrieve weights in the right-hand-side of the equation used to estimate the treatment effect. Results are again virtually unchanged. Attending the short course in financial education increases by 0.278 (s.e. 0.055) and 0.261 (s.e. 0.074) the overall performance in financial literacy and investment attitudes respectively, whereas it increases the average financial literacy self-assessment by 0.749 (s.e. 0.089).

The same battery of alternative approaches has been used to control for unit non-response in the laboratory experiment. Our findings are confirmed. When weighted regressions are adopted, the effect of our intervention on actual financial literacy, investment attitudes and self-assessed financial literacy is estimated to be 0.355 (s.e. 0.183), 0.555 (s.e. 0.152) and 0.806 (s.e. 0.185) respectively. When the Heckman procedure is implemented, they are 0.224 (s.e. 0.129), 0.456 (s.e. 0.136) and 0.721 (s.e. 0.193). When covariates are plugged in the equation, the estimates of the effects of interest are 0.231 (s.e. 0.129), 0.447 (s.e. 0.140) and 0.699 (s.e. 0.201).

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