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Agar Brugiavini - Danilo Cavapozzi - Mario Padula - Yuri Pettinicchi

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House of Finance | Goethe University
Theodor-W.-Adorno-Platz 3 | 60323 Frankfurt am Main

Tel. +49 69 798 34006 | Fax +49 69 798 33910
info@safe-frankfurt.de | www.safe-frankfurt.de

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*

Agar Brugiavini† Danilo Cavapozzi‡ Mario Padula§ Yuri Pettinicchi¶

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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 both a statistically and economically significant effect on subjective and objective assessments of financial knowledge. We show also that the intervention increases self-assessed more than actual financial knowledge.

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

JEL classification: D14, G11, I20

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†*Department of Economics, Ca' Foscari University of Venice, Cannaregio 873, 30121 Venice, Italy* E-mail: brugiavi@unive.it.

‡*Department of Economics, Ca' Foscari University of Venice, Cannaregio 873, 30121 Venice, Italy and NETSPAR*, E-mail: danilo.cavapozzi@unive.it.

§*Università della Svizzera italiana (USI), Facoltà di Scienze Economiche, IdEP, CSEF, and CEPR*, E-mail: mario.padula@usi.ch.

¶*SAFE - Goethe University Frankfurt, Theodor-W.-Adorno-Platz 3, Frankfurt am Main, D-60629*, E-mail: pettinicchi@safe.uni-frankfurt.de.

1 Introduction

Households are routinely called on to make crucial financial decisions regarding both the assets and the liabilities sides of their portfolios. On the assets front, arguably the most important decision is related to how and how much to save for retirement purposes. The switch from defined benefit to defined contribution social security systems shifts the burden of the saving decision to the individual. The question arises whether individuals are equipped to make these decisions. The same question arises in relation to the liabilities side. For instance, the choice of whether, how and how much to borrow to purchase a house has long-term consequences on household 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 with lower levels of financial illiteracy (for a survey see Lusardi and Mitchell 2014).[1] Despite the evidence, whether financial literacy has a causal effect on financial decisions remains an open question.[2] Gale and Levine (2011) review a large body 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 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. In addition, using a life-cycle it can be shown that financial literacy and portfolio choices are jointly determined without this implying a causal effect of the former on the latter (see Jappelli and Padula 2013, 2015).[3]

[1] Households appear to make several mistakes in the domain of financial decisions (see Campbell 2006). Examples are the low level of market participation (Haliassos and Bertaut 1995), the lack of portfolio diversification (Goetzmann and Kumar 2008), the disposition effects (Odean 1998), and the non-refinancing of fixed-rate mortgages in a climate of low interest rates (Canner et al. 2002). Calvet et al. (2009) construct an index of financial sophistication using Swedish administrative data, providing robust evidence of portfolio management mistakes. Other studies document the missing of profitable opportunities such as under participation in employer matching contributions Choi et al. (2011), or choices related to life insurance Agarwal et al. (2009).

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

[3] A word of caution about financial education programs is in Padula and Pettinicchi (2013) who show that financial education programs do not necessarily reduce financial market instability.

Whatever the causal interpretation of the association between financial literacy and behavior, lack of awareness of basic financial concepts has prompted the introduction of financial education programs in several countries. These programs are aimed at equipping household investors with knowledge related to a basic set of financial notions, and protecting them through the implementation of appropriate regulations.[4] However, policy makers need to know how to evaluate the effects of these programs and to understand whether (and how) financial education reduce illiteracy, and accordingly improve financial outcomes.

The literature provides little evidence on the effects of financial education programs. Most available financial education programs are 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. 2013 for Brazil and Romagnoli and Trifilidis 2013 for Italy); financial education in 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).

Becchetti et al. (2013) and Lührmann et al. (2015) are an exception; they use an experimental identification strategy to assess the effect of financial education programs on high-school students. Becchetti et al. (2013) do not find a statistically significant effect of the treatment on financial literacy but claim a positive effect on hypothetical behaviors. Becchetti and Pisani (2012) is a follow up study and suggests that students can learn from repeating similar surveys. Lührmann et al. (2015) discards the "survey" effect and finds a positive effect of 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 on financial literacy and attitudes to investment. To our knowledge this is the first paper to use on college students within a randomized treatment setting.[5]

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

[5]Previous works on financial education for young adults show little evidence with respect to financial literacy. The intervention takes the format of lectures to explain basic concepts related to financial topics to the students. In the US, Mandell (2008) evaluates the effects on financial knowledge of high school students. Cole et al. (2014) report no direct effect of mandatory education on financial attitudes,

Of course, university students are a special population but there are several advantages from a focus on them. First, all university students have completed the high-school education, and are equipped with the basic numerical notions needed to understand and 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, and tend to live with their parents and rely on parents' income to support their studies; some rely on scholarships or grants but 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 saving or debt, and often lack the basic budgeting notions needed to run a household. These characteristics make 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 according to certain relevant dimensions such as age and 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.

The goal of the paper is twofold. First, we assess whether a short course in financial education has a positive impact on subjective and objective assessments of financial knowledge. Second, we investigate the correlation between changes in subjective and objective assessments in order to evaluate to what extent improvements in self-assessed financial knowledge match actual improvements in familiarity with financial concepts.

The experimental subjects are students at a medium-sized university in the Northeast of Italy. The university has around 24,000 students enrolled in one of the several BA, MA or PhD courses in the following four areas: foreign languages, humanities, social sciences, and sciences. The population of interest consists of 24,737 students who enrolled in the academic years 2012-2014. The sample was obtained by adding to the students enrolled in the academic year 2013/2014 those who graduated in the academic year 2012/2013.

To evaluate the effect of the course, we conduct an experiment. To avoid 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 treatment

exploiting cross-state variations.

group received a short course on basic financial concepts, the control group received an arguably orthogonal course on the history of the Venetian lagoon. We performed the same experiment in 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, the treated students appeared more aware of basic financial concepts, such as interest compounding, inflation and diversification, compared to the control group of students. The second result of the intervention is the positive effect of the course on investment attitudes. The course allowed the treated group to be less prone to investment mistakes compared to the untreated subjects. The third result relates to the effect on self-assessed financial literacy. The short course increased the level of self-assessed financial literacy although interestingly this increase is larger than the real increase in knowledge.

The rest of the paper is organized as follows. Section 2 presents the identification strategy; Section 3 describes the data; Sections 4 and 5 present the results. Section 6 offers some conclusion.

2 Identification of the effects of financial education

To identify the effect of training on financial literacy and investment attitudes, we exploit a standard randomized trial treatment and control group structure. We assign individuals randomly to either the treatment or the control group. Individuals in the treatment group receive a short film on basic economic concepts such as interest compounding, inflation and risk diversification. The lecture lasts for about 20 minutes and is delivered by a male teacher who accompanies his lecture with slides. The course covers three topics: basic level interest compounding, inflation and risk diversification. The three topics are presented with the help of simple numerical examples, and whenever relevant, graphs.[6] The control group is given a lecture on the history of the Venetian lagoon. Similar to the treatment group, the course lasts for about 20 minutes and is delivered by a male teacher. We describe the course material in more details in Appendix A.

[6]The course is provided in Italian, but the English translation of the slides is available on-line, see http://www.pettinicchi.eu/slsc.pdf.

As part of the intervention, we asked a battery of questions to explore financial literacy and investment attitudes just before and immediately after the lectures to both the treatment and control groups. The average time to complete the questionnaire and to watch the video was 45 minutes. The questions are designed to elicit knowledge about basic financial concepts and the individuals' ability to utilize these concepts. The financial literacy questions related to the content of the lecture, namely interest compounding, inflation, and risk diversification. The investment attitude questions referred to hypothetical situations requiring application of the notions of interest compounding, inflation, and risk diversification. The questions were designed in such a way that appropriate usage of the notions of interest compounding, inflation, and risk diversification delivered the correct answer. The exact wording of the questions is reported in Appendix B.

The questions posed before and after the treatment were different in order to remove the effect of re-taking a test in a short span of time. However, the answers to the questions are fully comparable and if the question required (simple) numerical calculations we make sure that the before and after the course questions did not include the same calculations.

Finally, to control for the presence of heterogeneity in the treatment effect, we merged the data obtained from the intervention with selected data from the university administrative archives. The data contain information on the students' gender, degree (undergraduate and graduate), and area of study .

To give the students an incentive to participate and to provide the best possible answers, we designed a lottery with three prizes of latest generation laptop computers. [7] For each correct answer, the students received a lottery ticket. They were made aware of the reward by a message that appeared at the top of the screen. Participants did not receive feedback on their performance and were they are informed about how many lottery tickets they had gained only after data-collection had closed.

We administered the intervention in two ways: in the field and in the laboratory using the same internet platform obtained with LimeSurvey.[8] On the internet platform, each question appears on a separate page and respondents could only progress of they provided

[7]Participation in the experiment was not compulsory. We advertised it in the student community using institutional media (university website and newsletters, brochures distributed in public space) and informal networks (direct mailing, Facebook, student radio station) before and during the experiment.

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

an answer to each question.

In the field experiment, the subjects received an e-mail directing them to the platform where the survey and course were located. The subjects had 30 days in which to participate in the experiment but it had to be completed in one shot.

In the laboratory experiment, the subjects used individual computers and listened to the lectures using headphones. We ensured that they did not communicate with one another, and used visual separators between computers. Participants in the laboratory experiment were not allowed to consult manuals, textbooks or to browse the web to get hints about the answers to questions posed.

We ran the experiment in the field and in the laboratory for two reasons. First, although the intervention was standardized through the use of the graphical interface, in the field experiment we were unable to control for the effect of the experimental environment. To the extent that the effect of the environment in which the experiment takes place is the same before and after treatment, the identification design relies on the comparison between pre- and post-intervention outcomes.[9] However, the effect of the conditions under which the experiment takes place can change between before and after the treatment, which challenged our identification design. Therefore, to control for the conditions in which the intervention is administered, we replicated the experiment in the laboratory.

The second reason is related to costs on the part of the experimental subjects and the experimenter. The costs of administering the laboratory experiment are definitely higher than the costs of the field experiment. The cost of preparing the intervention does not depend on whether the intervention takes place in the field or in the laboratory but running the experiment in the laboratory involves additional costs for the participants, who have to go to the laboratory, and for the experimenter, who has to pay the costs of setting up and using the laboratory, and of the show up fee for participants. The obvious consequence of the difference in costs is that laboratory experiments reach a much smaller number of participants than a field experiment. Moreover, although the two experiments were targeting the same population, selection into participation may differ between the two experimental modes.[10] Therefore, running the experiment in the

[9]Notice that the before and after design is crucial to remove constant effects of the environment which are inherently unobservable. Furthermore, the before and after design allowed us to measure the learning effect, i.e. changes in the level of knowledge.

[10]Notice that our pre- and post-identification design takes care of the selection effect to the extent that

field and in the laboratory allows us to check whether the results depended on the costs of the experiment, and therefore provided grounds to identify the optimal way to administer the experiment.

We next discuss the measurement of financial literacy and investment attitudes, and provide some descriptive statistics.

3 Measuring financial literacy and investment attitudes

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

To measure financial literacy, we asked the "Big Three" questions common in the literature. These questions are labeled "Inflation", "Interest compounding" and "Diversification" to emphasize the notions they are meant to elicit.

The investment attitude questions put students in hypothetical situations where they were presented with in a set of alternatives from which to select. Only one of the available answers was correct. Students could make use of the same set of notions elicited by the "Big Three" questions to find the correct answer and avoid an investment mistake. In the "Real vs. Nominal" question, finding the correct answer requires calculation of the annual return from a financial asset net of inflation. In the "Investment plan" question, the notion of interest compounding has to be applied to compare correctly the returns from two investments. In the "Rule of 72" question, participants were asked to assess the doubling time for a loan.

The outcomes of interest for the financial literacy and investment attitude domains include whether each question was answered correctly as well as the overall number of correct answers per domain.

There is an additional question focusing on measuring the respondents' self-assessed financial literacy according to a numerical scale from 1 to 7, with 1 being the lowest and 7 the highest level.

All the questions were posed before and after the intervention and regardless of assign-

it is constant before and after the intervention.

ment to the treatment or control group. The next section provides descriptive statistics for all the outcomes of interest collected from the field or laboratory experiments. The participants are university students. They are selected with respect to the Italian population in that they all have a high school degree and are enrolled in an undergraduate or graduate program. Therefore, we expect a higher initial level of financial literacy than generally reported for the Italian population (see Fornero and Monticone 2011), to the extent that financial literacy is related to literacy and education more generally.

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 participants were undergraduates (71%), master students accounted for to 25% of the sample, and PhD students to 4%. Overall, the samples of students who completed the field and the laboratory experiment numbered 579 and 100 respectively. The sample size for the laboratory experiment is much smaller than the sample size for the field experiment due to space and resources constraints. These two samples of students are used in all the following analyses. In both cases, the sample distributions of gender and education align well with their population counterparts. The sample of laboratory experiment participants is characterized by an over-representation of students in economics at the expense of students of humanities, which can be related to the location of the laboratory close to the Department of Economics. While it should be noted that the selection does not apply to the field experiment, in Appendix C we investigate the effects on the results of unit non-response.

3.1 Descriptive statistics: field experiment

Table 2 reports the sample averages for all the outcomes of interest collected both before and after the intervention took place for the treated and control groups. Among the sample of participants who completed the experiment, 321 were assigned to the treated group and 258 to the control group.

Table 2 shows that before the intervention the differences in average outcomes between

the treated and control groups were negligible but they increased after the intervention. The probability of answering to the questions in the objective financial literacy and investment attitude domains correctly increases for the students in the treated group but remains rather constant for those in the control group. The biggest variations are 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 it increased by about 8% for the participants in the short financial course and decreased for the control group. These comparisons suggest that the short course in financial education had a positive impact on participations' the financial literacy and investment attitudes which would not otherwise have occurred.

Finally, it is worth noting that the self-assessed financial literacy, which measures the respondents' confidence in their financial education, increased by 25% for the treated group and by 3% for the control group. This descriptive evidence suggests that the short course might affect participants abilities to use the tools needed to manage financial portfolios as well as their self-confidence in their ability to manage a financial portfolio.

3.2 Descriptive statistics: laboratory experiment

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

The short course in financial education had a positive shock on participants' skills. Those who received the short course were 14% more likely to answer the "Inflation" question correctly compared to a variation equal to 5% for the control group. If we look at the results for the "Interest compounding" question, we observe 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 attitude questions. With the exception of the "Diversification" question, the improvement in the likelihood of

correct answers after the intervention is noticeably higher for the treated group compared to the control group.

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

4 Evidence from the field

4.1 The effect of financial education on financial literacy and investment attitudes

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 randomly assigns participants to the treated and the control group. 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, 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 the value 1 to participants in the treated group and 0 to those in the control group. The coefficient of the treatment dummy is the difference-in-difference estimator of the causal effect of the short course in financial education.

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 refers to the number of correct answers to these questions. Table 5 is similarly constructed, with columns 2 to 4 referring to "Real vs. Nominal", the "Investment plan", and the "Rule of 72" questions, and column 5 referring to the number of correct answers.

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 overall performance in this domain by 0.23. Among those who attended the short course the overall number of correct answers increases by 0.21, while 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 was around 2.3 before the intervention. Then, receiving the short course increases the overall performance by about 10%. The effect is mostly due to increased awareness of the notions of inflation (5%) and interest compounding (18%), while the effect on diversification is negligible.

Turning to the results for 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 of which require the students to make use of the notion of interest compounding. Again, the effect is sizeable since it amounts to about 12% of average pre-intervention levels.

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

Students are a homogeneous population in many respects. All students are high school graduates and most are aged between 18 and 25. Most have similar socio-economic backgrounds and come from the same geographical area. However, there are various sources of heterogeneity that can be relevant to assessing the effect of financial education. We investigate gender, field of study, and level of education differences.

The recent literature emphasizes gender differences in financial literacy and behavior.[11] 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 attitude (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 for males and females. In contrast, the differences between genders are 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).

Field of study is another potentially relevant dimension of heterogeneity. Therefore, we

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

distinguish for the effect of financial education between economics, humanities, languages and sciences. The results are reported in Table 7; the top panel focuses on financial literacy and the bottom panel presents investment attitudes. The effect on financial literacy is positive for all study fields, and is bigger 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 among study fields 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 among study fields, but larger for sciences and humanities, and smaller for economics and languages. Interestingly, the effect of the course on knowledge is more pronounced for economics and languages students, and less so for students in the other disciplines.

Another dimension of heterogeneity is level of education. The population of interest consists 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 on undergraduate students, while for investment attitudes the effect is similar between undergraduate and graduate students. Finally, we explore the differences for self-assessed financial literacy. Table 10 splits the sample between undergraduate and graduate students and regresses changes in self-assessed financial literacy scores on the treatment dummy. The effect is strong for both undergraduate and graduate students.[12] This result contrasts with the effect on actual knowledge, which is much smaller and hardly different from zero for graduate students. The evidence points to a divergence for self-assessed knowledge, an issue which 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 self-assessed skills of participants. A natural question would be whether whose confidence in their skills increases also learn more from the course. To address this issue, we assess the correlation between the variations in students' actual financial

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

skills and variations in their self-confidence levels. In addition, we 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 measured as the number of correct answers to the financial literacy question.

Column 2 of Table 11 indicates that 7.6% is the relative frequency of participants whose self-rated financial knowledge has decreased after the intervention. This percentage can be broken down in 1.9% of participants whose knowledge is also decreased, 4.15% of participants whose knowledge has not changed and 1.55% of participants whose knowledge has increased. The other columns can be similarly interpreted. The degree of correlation between changes in actual and self-assessed knowledge is therefore larger the closer to 100 are 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 deteriorates. Therefore, Table 11 points to the limited correlation between actual and self-assessed knowledge. The latter increases in 41 percent of cases but actual knowledge increases in only just below 11 percent of cases and in 27 percent of cases is 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 in 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.

This pattern is repeated 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 always has a significant and positive effect even controlling for variations in actual financial literacy (column 2) and investment attitudes (column 3).

The additional evidence suggests that considering improvements in self-assessments

as real 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 driven entirely by an actual improvement in the skills individuals need to manage financial portfolios effectively.

5 Evidence from the laboratory

We next analyze the results from the laboratory experiment. Variable definition and estimation strategy are the same as applied in the field experiment case. Table 14 reports the results for the financial literacy domain. Receiving the course increases the overall number of correct answers by 0.23. This effect is very close to its analogue for the field experiment extending even to its implications in terms of percentage variation in overall performance, which is around 10%. This variation is driven by improved performance in the "Interest compounding" question. The probability of answering this question correctly increases by 0.21 percentage points due to receiving the course.

Table 15 shows the effect of our intervention on investment attitudes. The effect on 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 an average increase of 24% in the outcome of interest. The variation in overall performance is driven by the effect on the "Real vs. Nominal" and "Investment plan" questions.

Similar to the field case, our intervention consistently produces a positive and significant effect on 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 assess whether there is a mismatch between the variations in the self-assessed and actual knowledge of financial tools. Table 16 reports the joint distribution of actual and self-assessed financial literacy. Its structure mirrors the structure of Table 11. For more than 50% of the sample the variations in actual and self-assessed financial literacy are consistent. However, for almost 70% of those participants declaring an improvement in their self-assessed financial literacy, we observe that their actual financial literacy remained at pre-intervention levels or even deteriorated. Overall, whereas actual financial literacy improves for only 20% of the sample, self-assessments

improve for more than 40%. Table 17 reports the joint distribution of actual investment attitudes and self-assessed financial literacy. The results are similar 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 Table 18 column 2. The treatment dummy remains a strong predictor of self-assessment changes even after controlling for the variation in actual performance. Everything else remains constant, recipients of the course show self-assessed financial literacy improves by 0.66 points. Conditioning on the variation in the actual financial literacy produces a negligible decrease in the parameter for the treatment dummy (lower than 10%). The results are similar if the total number of correct answers in the financial literacy domain is replaced by its counterpart for investment attitudes (see Table 18 column 3). As in the field case, these findings clearly suggest that the short course in financial education induces an increase in self-assessed skills that is not entirely explained by the improvement in actual skills.

6 Conclusions

There is a large and growing literature showing that large fractions of the population lack the basic skills to make sound financial decisions. The evidence has prompted a number of financial education initiatives around the world. These initiatives often take the form of education programs but rarely are designed to be evaluated.

The primary question is whether financial education is effective for enhancing the level of financial literacy.

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

The results are remarkably similar between the field and the laboratory experiment. Therefore, while the laboratory represents an ideal environment for delivering the course,

it is still effective when delivered to experiment subjects in an uncontrolled environment.

Our evidence shows a non-negligible effect on financial literacy and investment attitude but an even larger effect on the level of self-assessed financial literacy in a population of university students. The exercise reveals an interesting pattern. The effect of financial education seems to improve what individuals think they know more than what they 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 being better equipped to take financial decisions.

Our results imply an important caveat related to the effectiveness of financial education initiatives. The increased "self-confidence" seems to be a necessary by-product of financial education.

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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 answers	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 answers	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 answers	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 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 questions are 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.

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, whenever possible.

Appendix C Unit non-response

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

Our identification strategy already addresses unit non-response 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 non-response.

However, to assess the robustness of our results to unit non-response, 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 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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