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DISCUSSION PAPER

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# Testing an Investment Simulation Tool – Effects on Knowledge, Confidence, and Motivation

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# Testing an investment simulation tool – Effects on knowledge, confidence, and motivation

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**Abstract**

Online brokers and robo advisors frequently use investment simulation tools to visualize portfolio choices and illustrate investment scenarios to their clients. I conduct a survey experiment to study whether people understand such a simulation tool. I analyze how using it might affect individual financial knowledge, confidence in financial decision-making skills, and motivation to deal with the topic of "saving and investing". In addition, an advice-giving task is implemented to test for mutual reinforcement effects. I find that even a simplified simulation tool is challenging to understand for a lot of individuals. Only those who are able to comprehend the tool are able to improve their financial knowledge related to the tool's content. A successfully completed advice-giving task boosts confidence for those with initial below-median confidence levels. Furthermore, there is a positive short-term effect on motivation. In the medium term, however, participants are rather discouraged to take further actions. Overall, this calls for the careful design and implementation of investment simulation tools, especially for less financially literate individuals.

***Keywords:*** *Behavior, finance & microfinance, framing, simulation tool, giving advice*

***JEL Classification:*** *C90 (Design of Experiments), D14 (Household saving, Personal Finance), G11 (Portfolio choice, Investment Decisions), G53 (Financial literacy)*

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## 1. Introduction

In recent years, online brokers and robo-advisors have emerged to facilitate investing in the capital market and have become popular among the general population. This is an important development since investing in the capital market is one option to achieve greater returns on savings and diversify risks, enabling households to accumulate more wealth over time. Current literature focusses on the effects of online brokers on investment behavior, for example, portfolio diversification (e.g., Loos *et al.*, 2020; Rossi and Utkus, 2020b), the role of behavioral biases (e.g., D'Acunto *et al.*, 2019; Bhatia *et al.*, 2020), default investment options (e.g., Bräuer, 2021; Hornuf *et al.*, 2024), and risk taking behavior (e.g., Tertilt and Scholz, 2018; Loos *et al.*, 2020). Interestingly, a lot of platforms use simulation tools to visualize portfolio choices and illustrate investment scenarios. Here, however, to the best of my knowledge, no empirical evidence exists on how these simulation tools might affect user behavior and their attitudes[2], although research has shown that the way information is presented influences user behavior (e.g., Frydman and Wang, 2020).

In this paper, I implement and test a digital investment simulation tool and provide first evidence on how the usage of such a tool influences users' financial knowledge, confidence, and motivation. The layout is based on the design of simulation tools implemented by commercial robo-advisors and online brokers. I draw on core elements of their settings, e.g., the investment amount, the share of risky assets, and the investment horizon. My simulation tool displays three forecast scenarios over a fixed time horizon of 20 years. Therefore, my focus is on long-term savings prospects, such as saving for retirement. In contrast to the very complex simulation tools used in practice, in this very simplified tool, only two features can be adjusted manually: the monthly savings amount and the share of risky assets in the portfolio. I focus on the following three outcomes. First, I check whether users actually understand the tool. This is relevant because it is such a prominent feature used by robo-advisors. Second, I test for learning effects. Do users improve their financial knowledge when working with the simulation tool? This is important because financial literacy is a key competency for stock market participation (e.g., van Rooij *et al.*, 2011; Bucher-Koenen *et al.*, 2025a), financial resilience (e.g., Klapper and Lusardi, 2020; Cziriak, 2022), and retirement preparedness (e.g., Lusardi and Mitchelli, 2007; Bucher-Koenen and Lusardi, 2011) (for an overview, see Lusardi and Mitchell, 2023). Third, I investigate effects on motivation, i.e., are users more or less motivated to deal with the topic of "saving and investing" after using a financial simulation tool? It is a crucial step toward financial well-being that newly acquired information or knowledge is translated into taking further actions if necessary (e.g., Fernandes *et al.*, 2014; Kaiser and Menkhoff, 2017). Even though measuring future actions is out of the scope of my experimental setting, motivation might be a tentative proxy. Hence, I am interested in the following research question: Does the understanding and usage of an investment simulation tool influence users' financial knowledge and motivation to deal with the topic of "saving and investing"?

[2] For a literature review on robo-advisors, see, e.g., Cardillo and Chiappini (2024) and Mathew *et al.* (2024).

To answer these questions, I conduct an online experiment among 544 individuals asking them to test the simulation tool. The sample is representative of smartphone users in the German adult population aged 18 to 55 years. In order to track potential learning effects through the usage of the tool, I frame the simulation tool in two ways (*framing treatment*). The treatment group sees the tool in a finance frame. Here, the tool illustrates the trade-off between risk and return on the capital market over a 20-year time horizon. Participants can choose a monthly savings amount and the share of risky assets in the portfolio. The control group receives the tool in a neutral frame that illustrates a trade-off independent of the financial context without using any finance-specific jargon. Participants face the trade-off between two tree species, which differ in their growth rate and pest resistance.[3] The presentation in the neutral frame is structured analogously to the finance frame. Instead of choosing a monthly savings amount, participants can choose the number of trees planted every year over 20 years. Analogously to the share of risky assets, participants in the control group can choose between the "risk-free tree" and the "risky tree".

In the context of financial decision-making and wealth accumulation, not only financial literacy but also confidence in one's financial decision-making skills plays an important role (e.g., Bucher-Koenen *et al.*, 2017; Bannier and Schwarz, 2018). Bucher-Koenen *et al.* (2025) show that one third of the gender gap in financial literacy can be explained by women's lower self-confidence in their financial abilities. One way to promote self-confidence is to assign individuals an advice-giving task. In the psychology literature, Eskreis-Winkler *et al.* (2018) find that struggling students who were asked to *give* advice – compared to those *receiving* advice from an expert – became more confident, which further translated into higher motivation to improve their own performance. This result holds true when generalized to a representative student sample (Eskreis-Winkler *et al.*, 2019). In the economic literature, empirical evidence on advice-giving is still scarce. Osun (2024) shows that women are more reluctant to give advice when the task is difficult. While performance and self-confidence impact advice giving, these factors cannot fully explain the gender gap. Among retail investors, giving advice to family and friends is wide-spread. Giving advice rests on trust and expertise, especially reputational costs of advice-giving appear important (Balakina *et al.*, 2024). When looking at *self-advice*, Lee and Qin (2025) find positive effects on remote workers' productivity and confidence. Hence, I augment the experimental design with an additional element: an advice-giving task with regard to finances. Thus, the fourth user outcome of interest is confidence in one's abilities to make good financial decisions. I aim to shed light on the research question: Does an advice-giving task influence individuals' confidence in their financial decision-making capabilities and their motivation to deal with the topic of "saving and investing"?

[3] The trade-off in the neutral frame is constructed as follows: On the one hand, slow-growing trees ("risk-free trees") produce lower yields on average, but are more resistant to pests. This means that yields hardly fluctuate. On the other hand, fast-growing trees ("risky trees") produce higher yields on average, but are less resistant to pests. This means that yields fluctuate more.

To answer this question, an *advice-giving treatment* is implemented directly after the simulation tool in the survey. In the treatment group, respondents are asked to provide hypothetical financial advice to a friend with regard to saving for retirement in an open text format. In addition, I include three closed questions that require advice for specific hypothetical scenarios, e.g., with regard to investing in the capital market or seeking professional advice. Participants in the control group are not asked for additional advice and skip this part of the questionnaire. The experiment is implemented as a randomized 2x2 between-subjects design. While the focus of the analyses is to look at the framing treatment and advice-giving treatment separately, the experimental design allows to test potential interaction effects as well.

The experiment provides four main findings. First, the majority of the participants understands the simulation tool independent of the tool's framing. When being asked to read a value off the interactive graph, 58.1% of the participants are able to do so. When the comprehension tasks become more difficult and participants have to adjust a value in the simulation tool and then read off a value from the interactive graph, the share of correct answers slightly decreases. Interestingly, the cumulative results suggest that participants either understand the tool (44.7% are able to answer all three comprehension questions correctly) or not (34.0% give no correct answers). Basic financial knowledge is a crucial prerequisite for understanding the tool. Furthermore, participants are generally able to accurately assess their ability to give the correct answer, measured by a confidence question after each comprehension question. For the finance frame, I find that participants select a share of risky assets for themselves that corresponds to their financial risk preferences. General feedback questions reveal that participants find the interactive graph very comprehensive, helpful, informative, and not too complex. Again, the response patters do not differ between the neutral frame and the finance frame. While these findings are by and large encouraging, one third of the participants does not understand the simulation tool. Given that the tool is relatively simple and each feature is explained in detail, the design and implementation of such simulation tools in the future has to be mindful with respect to different levels of prior knowledge.

Second, I include three advanced financial literacy questions after the experiment to measure learning. One question concerns the volatility of returns on various types of investments and is therefore directly related to the topic on which participants receive information in the simulation tool. Only for this question do I detect learning effects. The learning effect is visible for participants facing the simulation tool in the finance frame – but not in the neutral frame. Thus, there is no transfer of knowledge even though the underlying concepts presented in the two frames are identical. When conditioning on understanding the tool, only those who are able to answer one to three comprehension questions correctly, are more likely to answer the question on volatility of returns correctly. Put differently, understanding the tool is a crucial prerequisite for learning.

Third, although neither the use of the simulation tool in the finance frame nor the advice-giving task are able to boost participants' confidence in their ability to make good financial decisions, there is an

increase in confidence among certain subgroups. When looking at those who are able and willing to give financial advice and have below-median confidence before the experiment, I find a positive effect of the advice-giving treatment on individuals' confidence after the tool. Further, participants who understand the tool in the finance frame are more confident to participate in the stock market. Hence, this is an important research topic that should be further investigated in the future.

Fourth, the advice-giving treatment increases motivation to deal with the topic of "saving and investing" directly after using the simulation tool for those who are able and willing to give financial advice. Confidence after the tool seems to drive this result. This positive effect, however, does not translate into taking further actions. To tentatively proxy motivation to take further steps with regard to finances, participants have the opportunity to download additional information material at the end of the survey. A total of 41% of participants take advantage of this free offer. However, significant differences between the treatment and the control groups become evident. Participants both in the finance frame and in the advice-giving treatment are significantly less likely to download additional material. Here, the overall interaction effect is statistically significant, i.e., participants seeing the tool in the finance frame and giving advice are approximately 18 p.p. less likely to download additional material compared to participants seeing the tool in the neutral frame without giving advice. This shows that providing further information at the end of a questionnaire might not be the most efficient way to engage participants and distribute additional learning material.

My contribution to the literature is threefold. First, I contribute to the literature on understanding online/ digital finance tools by testing a widely implemented investment simulation tool. Investment simulation tools are not only extensively used in the finance industry (e.g., D'Acunto *et al.*, 2019; for a review see Goldfarb and Tucker, 2019), but also in the retirement planning context (e.g., Daminato *et al.*, 2024), for example. Across Europe, national pension dashboards have been introduced to provide individuals with an overview of their future pension income and to promote pension planning. For Germany, Bucher-Koenen *et al.* (2022) analyze a tool which provides an overview of current pension claims across all pillars of the pension system. They find that the tool decreases pension uncertainty and induces an increase in saving. The latter effect is particularly strong for less financially literate individuals. Goda *et al.* (2023) show that an interactive retirement savings calculator positively affects average annual retirement contribution among U.S. workers. Since the effect is stronger for individuals with higher financial knowledge, they conclude that this tool functions as a complement rather than a substitute for financial ability. Goda *et al.* (2014) show that providing retirement income projections positively influences savings behavior. Moreover, simulation tools are used to foster understanding of risk by experienced-based learning (e.g., Kaufmann *et al.*, 2013; Bradbury *et al.*, 2015, 2019). By tracking participants' behavior within the tool in addition to their final investment decision, I contribute to a more in-depth understanding of how users handle the tool rather than taking it as given.

Second, I contribute to the learning literature in general and to the literature on understanding and visualizing economic concepts and relationships in particular. The literature shows that individuals struggle to understand concepts like exponential growth (e.g., Goda *et al.*, 2019; Ciccione *et al.*, 2022). Ring and Oberrauch (2024) find that higher education students execute basic graph operations well, but have difficulties with complex tasks such as comparing quantities. Visualizing uncertainty is particularly challenging. Westerbeek *et al.* (2025) test three ways to visualize uncertainty surrounding expected pension benefits. The authors find that navigation and fan visualizations are perceived almost identical while dot plots are considered more complex but insightful. Nevertheless, using visualization tools to display data or concepts can make information more accessible and encourage learners of all age groups to engage (for a systematic review, see Du *et al.*, 2021). Moreover, gamification can support and motivate individuals when learning about finances as well (e.g., Pal *et al.*, 2021; Wang, 2023). With my simulation tool, I display a complex economic relationship, namely the risk and return trade-off on the capital market, and make it accessible to the broader population. The interactive graph incorporates growth patterns (displayed as a forecast of different investment choices) and potential uncertainty (captured by three investment scenarios). I extend the literature by using extensive explanations as well as including comprehension questions which test participants' ability to understand the interactive graph. The framing treatment enables me to test whether participants also improve their financial knowledge when facing the tool.

Third, I contribute to the literature on *giving* advice. Previous studies mainly focus on *receiving professional* financial advice. Here, factors under consideration are the quality of advice also with regard to gender differences (e.g., Bucher-Koenen *et al.*, 2025b; Bhattacharya *et al.*, 2024; for a review, see Reuter and Schoar, 2024), the role of trust (e.g., Lachance and Tang, 2012), the role of biases and belief updating (e.g., Mullainathan *et al.*, 2012; Schoar and Sun, 2024; Andries *et al.*, 2025), and the role of financial literacy (e.g., Calcagno and Monticone, 2015; for an overview see Stolper and Walter, 2017). Moreover, *receiving informal* advice (e.g., Lusardi and Mitchell, 2008; Hurwitz and Mitchell, 2025) and advice from robo-advisors (e.g., Rossi and Utkus, 2020a) are analyzed. Interestingly, in the psychology literature, giving advice is associated with an increase in self-confidence (Eskreis-Winkler *et al.*, 2018, 2019). In an economic context, evidence on advice-giving and its impact on confidence is still scares (e.g., Balakina *et al.*, 2024; Osun, 2024; Lee and Qin, 2025). I extend this literature by applying an advice-giving task in the financial context for a sample of the German adult smartphone users. Furthermore, in my experimental design I combine an investment simulation tool and an advice-giving task. Jha and Shayo (2024) find that collecting investment experience itself increases confidence in one's financial skills. My experimental setup allows to disentangle learning and confidence effects. Online platforms with investment simulation tools might be especially beneficial for less confident individuals because the threshold to access might be perceived to be lower. The role of giving advice to others as a boost to one's confidence is still an open question in a finance context.

The paper is structured as follows: Section 2 introduces the survey and experimental design, including the simulation tool. Section 3 describes the data set, contains summary statistics, and defines the main outcome variables. Section 4 analyzes participants' understanding of the simulation tool and evaluates the advice-giving treatment. In Section 5, the results for financial knowledge, confidence, and motivation are assessed. Section 6 concludes.

## 2. Survey and experimental design

*Survey design*

I conduct an online survey consisting of seven sections. The experimental components are embedded in Sections 3 and 4. Figure 1 summarizes the overall structure of the survey.

At the beginning of the survey, participants are asked about their socio-demographic data and risk preferences. Then, confidence with regard to financial decision-making and basic financial knowledge are queried. Approximately in the middle of the survey, the simulation tool is introduced. Afterwards, half of the participants are asked to give financial advice. Next, confidence is measured again, followed by questions on motivation and advanced financial knowledge. Finally, the survey concludes with questions on prior experiences with finances and financial advice as well as income and wealth. A list of all questions with their respective answer options can be found in Appendix D.

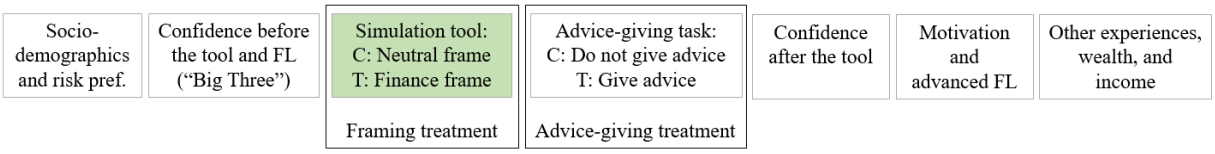
### 2.1. Simulation tool and framing treatment

*The simulation tool*

For the experiment, I implement a simulation tool that resembles investment simulation tools used in practice by online brokers such as, for example, Whitebox, Quirion, Solidvest, and Smavesto. While investment simulation tools may vary in their complexity, they have four main elements in common. First, customers have to decide how much money they would like to invest. They can usually choose a monthly savings amount and a one-time payment. Second, they can select how much risk they are willing to accept in their portfolio.[4] Simulation tools typically provide either verbal risk scales or the option to choose the share of risky assets in the portfolio directly. Third, the forecast development of the investment decision is presented in a graph. The investment horizons at display vary and often can be adjusted individually. Finally, the graph contains several development scenarios, e.g., "positive development", "average development", and "negative development".

[4] All investment advisors, both physical and online, have to take their clients' individual risk preferences into account (BAFIN, 2024). Hence, all online brokers include some form of risk assessment (for a review see, e.g., Tertilt and Scholz, 2018). Consequently, depending on the risk preferences, not all risk categories might be available to the client.

**Figure 1: Survey design**




Notes: Figure 1 shows the survey structure including the framing treatment and the advice-giving treatment.

To mimic the experience decision-makers face in real-life investment decisions, I construct a simulation tool featuring these four elements. However, I limit the features that the participants can manually adjust to setting the monthly savings amount and the share of risky versus risk-free assets in the portfolio. I reduce the tool to these two features to ensure clarity and to take into account the limited time available for the experiment in the survey.

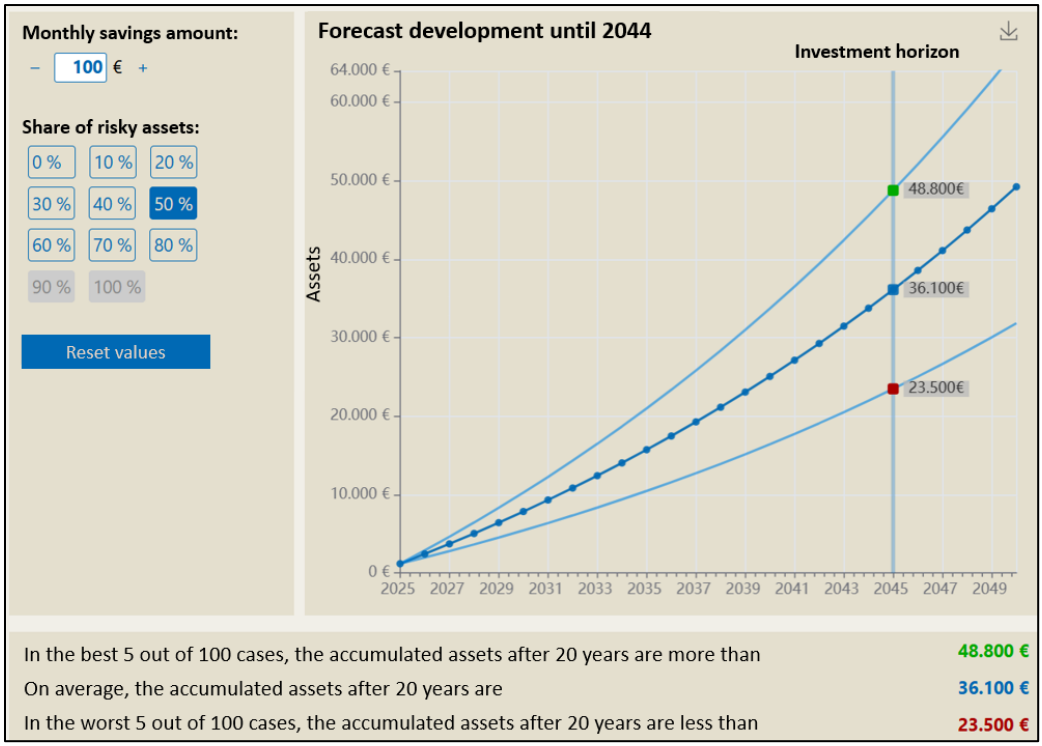
The simulation tool for the financial decision-making is displayed in Figure 2, Panel A. In the upper left corner of the simulation tool, the monthly savings amount can be adjusted manually in increments of 10 Euro by clicking on the plus or minus sign. The default amount is 100 Euro. For simplicity, the tool does not include the option to choose a one-time payment. Below the monthly savings amount on the left-hand side, the share of risky assets can be selected manually by the participants. In this simplified illustration, participants can only choose between a risk-free asset and a risky asset. The risk-free asset is defined as a savings account with an annual return of 1%. The risky asset is defined as saving in stocks with an average annual return of 5.9%.[5] In 10 percentage point increments, the participants can click on the 0%, 10%, …, 100% symbols. The default is a 50% share of risky assets in the portfolio. The 90% and 100% symbols are gray shaded and participants are made aware that they are rarely offered in practice.[6]

The participants can directly see the outcome of their decisions in a graph on the right-hand side of the interface. The graph shows the projected development of accumulated assets over 20 years based on the selected savings amount and the share of risky assets in the portfolio. The calculations underlying the visualized simulation are based on Bucher-Koenen *et al.* (2019).[7] The x-axis shows the investment horizon in years and the y-axis shows the accumulated assets in Euro. Three scenarios are presented to the participants: The "best 5 out of 100 cases" (green), the average scenario (blue), and the "worst 5 out

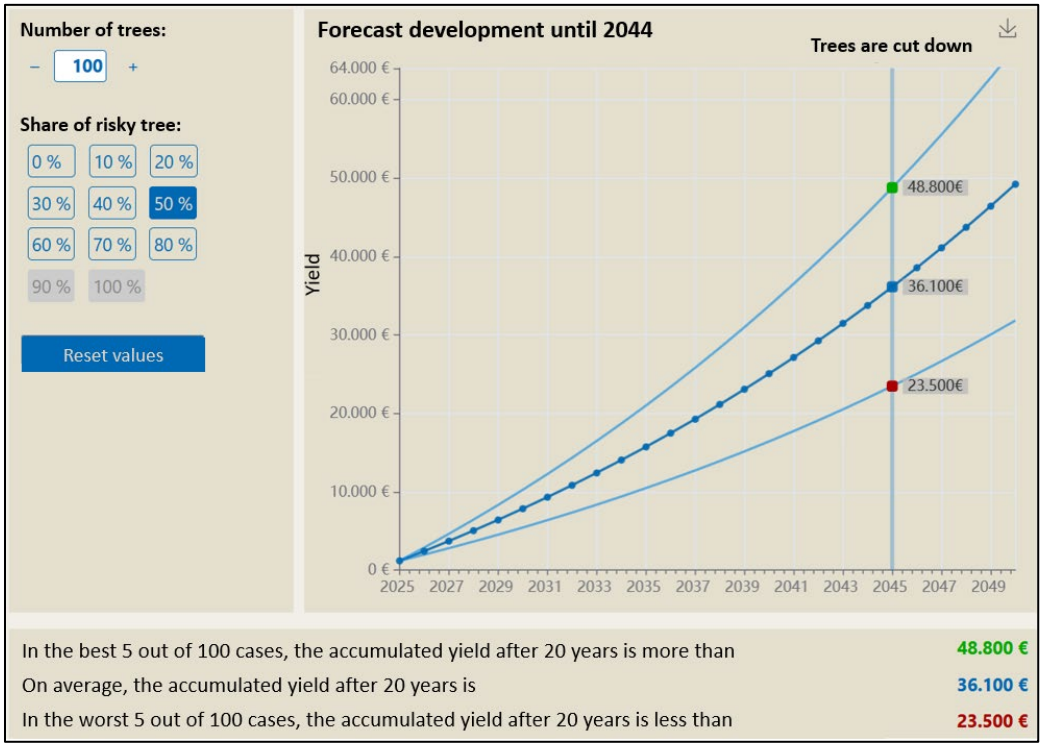
[5] This corresponds to the average annualized return of the MSCI World Index in Euro for the last 25 years.
[6] In real-life, investment advisors have to adjust the available risk categories in accordance with their client's risk preference. In my survey, the participant's risk profile is not linked to the selectable shares in the simulation tool. Participants can still select the gray shaded shares even though it might not correspond to their risk preferences.
[7] All technical details concerning the underlying simulations can be found in Appendix A.

**Figure 2: Simulation tool with framing treatment**

**Panel A:** Tool with finance frame (treatment group)




**Panel B:** Tool with neutral frame (control group)




Notes: Figure 2, Panel A shows a screenshot of the simulation tool in the finance frame. Panel B shows a screenshot of the simulation tool in the neutral frame.

of 100 cases" (red). Below the graph, the three scenarios are explained verbally.[8] To connect the graph to the explanations, the numbers below the graph color match the respective dots in the graph.

*Experimental flow*

To ensure that participants understand the simulation tool and its context, the tool is introduced in several steps. Figure 3 shows the experimental flow in the simulation tool. The exact phasing of the experimental steps as well as the slide show can be found in Appendix B, Part 2.

First, an introductory text is shown to alert the participants that they will face an interactive graph as the next part of the survey. Second, the different features of the simulation tool are explained step by step. Here, a slide show is used to ensure that the participants are aware of all features and understand the setting.[9] Third, the participants see the tool and can explore it independently. Fourth, three comprehension questions are introduced to measure participants' understanding of the tool. Correct answers are not necessary to proceed with the questionnaire. Fifth, the participants are asked to input the values (i.e., the monthly savings amount and share of risky assets) they would choose for themselves in this hypothetical setting. Finally, feedback questions on the comprehensibility, helpfulness, complexity, and informativeness of the simulation tool are asked.

*Framing treatment*

In order to track learning effects of using the tool, I also implement the simulation tool in a neutral frame. The neutral frame illustrates a trade-off that is independent of the financial context of interest. Instead, it shows a cultivation decision based on an example from forestry. Participants are asked to think about the trade-off between a "risky" and a "risk-free" tree species but do not learn anything new about finance. An additional advantage of this design is that it ensures that all participants are burdened equally during the survey (Haaland *et al.*, 2023). The simulation tool in the neutral frame has the same structure as in the finance frame (see Figure 2, Panel B).[10] Instead of choosing the monthly savings amount and the share of risky assets in the finance frame, participants in the neutral frame can choose the number of trees planted every year and the share of the "risky" tree in the planting decision.[11] The two tree species differ in their growth rate and pest resistance. On the one hand, the "risk-free" trees are

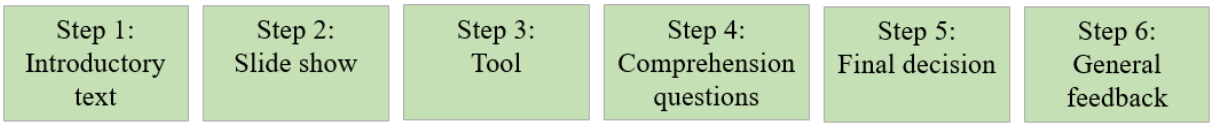
[8] For the best case scenario: "In the best 5 out of 100 cases, the accumulated assets/yield after 20 years are more than XX Euro". For the average scenario: "On average, the accumulated assets/ yield after 20 years are XX Euro". And for the worst case scenario: "In the worst 5 out of 100 cases, the accumulated assets/yield after 20 years are less than XX Euro".

[9] Clicking from one slide to the next is only possible after three seconds to prevent rapid skipping and to avoid misunderstandings.

[10] The only exception is Step 5 in the experimental flow (see Figure 3). Participants in the neutral frame are not asked to make a choice for themselves. The "tree" decision might not be tangible or practically feasible for a lot of participants in real life.

[11] The underlying assumptions regarding risk and return parameters are identical for both frames.

**Figure 3: Experimental flow in the simulation tool**




Notes: Figure 3 summarizes the six steps participants go through when introduced to the simulation tool. The steps are identical for the neutral framing and the finance framing with the exception of Step 5. Only participants in the finance frame are asked to submit a final choice.

slow-growing and produce lower yields on average, but are more resistant to pests. This means that yields hardly fluctuate. On the other hand, the "risky" trees are fast-growing and produce higher yields on average, but are less resistant to pests. This means that yields fluctuate more. Analogously to the investment horizon, the trees will be cut down after 20 years.

### 2.2. Advice-giving treatment

It is still an open question whether an advice-giving task can boosts confidence in a finance context. This is relevant because confidence plays an important role for various economic outcomes, for example, financial literacy, stock market participation, and wealth accumulation (e.g., Bannier and Schwarz, 2018; Jha and Shayo, 2024; Bucher-Koenen *et al.*, 2025a).

The advice-giving treatment is implemented directly after the participants faced the simulation tool (see Figure 1). Participants in the control group are not asked to give financial advice. Participants in the treatment group are asked to complete two tasks. First, they should give advice to a friend. The task is phrased identically for both the neutral and the finance frame and reads as follows:

> *What tips would you give a friend when it comes to saving for retirement? Please describe your advice in a few short sentences or bullet points. [Open field]*

Second, to make this treatment stronger, I also include three closed questions that refer to specific examples:

- *Would you recommend investing in the capital market to a friend?*
- *Please think of a friend who is just starting out in working life. Would you advise him or her to start saving for old age straight away?*
- *Please think of a friend who has no experience with pensions and finances. Would you recommend that a friend to seek professional advice on pensions and finances?*

The answer scale to the closed questions is defined from 0 meaning "Not recommend at all" to 10 meaning "Highly recommend".

**Table 1: Experimental design**

Table 1 presents the 2x2 between-subjects experimental design. It includes the respective numbers of observations for the four treatment groups and their percentage shares.

| | | Framing treatment | |
|---|---|---|---|
| | | Neutral frame | Finance frame |
| Advice-giving treatment | No advice | Group 0<br>N = 142 (26.1%) | Group 1<br>N= 129 (23.7%) |
| | Advice-giving task | Group 2<br>N = 134 (24.6%) | Group 3<br>N = 139 (25.6%) |

### 2.3. Experimental design

The framing treatment and the advice-giving treatment are implemented in a 2x2 between-subjects design. Participants are allocated randomly into one of the four treatment groups. Table 1 depicts the 2x2 between-subjects design along with the respective sample sizes of each treatment group.

## 3. Data and summary statistics

### 3.1. Data set

To study the effect of an investment simulation tool and an advice-giving task on financial knowledge, confidence, and motivation, I conduct an online experiment among N=544 individuals approximately representative of smartphone users in the German adult population aged 18 to 55 years.[12] Representativeness refers to the age (18-55 years), gender, education, and region of origin (Bundesländer) of the participants in relation to the overall German population.[13] After a pilot study with N=100 participants, the survey was implemented between February 9 and March 14, 2024. I provided the survey agency *GIM Gesellschaft für Innovative Marktforschung mbH* with links to the self-completion online questionnaire which included the simulation tool and the experiment.[14] On average, participants took 16 minutes to complete the survey. The survey agency paid the remuneration to the participants. There are no further financial incentives for the participants during the experiment. Appendix E contains further details on the data set and the selection process.

[12] Participants could fill out the survey using a smartphone or a desktop computer. Note that there was a mismatch in the set-up of the framing treatment for desktop users. I.e., desktop users in the neutral frame wrongly saw the introductory slides from the finance frame, and vice versa in the finance frame. Consequently, the framing treatment is no longer clear-cut with regard to the use of financial jargon for this group. Thus, N=458 desktop users are excluded from the analyses. The results of the paper are based on N=544 smartphone users receiving the correct framing treatment.

[13] While this might not necessarily be the target group of robo-advisors – who rather address younger and tech-forward individuals –, I would like to widen the scope to a broader audience who might also benefit from such simulation tools (Tiberius *et al.*, 2022).

[14] The sample was recruited using two panels. The first panel is GIM's own *offline-recruited GIMpulse panel* (N=213). To ensure representativeness, the sample was extended using the *online Talk-Panel* (N=331). All participants were contacted via e-mail. The exact phasing of the contact e-mail can be found in Appendix B, Part 1.

### 3.2. Summary statistics

Table 2 shows the summary statistics of the participants' socio-demographic characteristics and the control variables used in the analyses. Columns 1 and 2 contain the mean and the standard deviation of the full sample (N=544). A list of all variables with their respective definitions can be found in Appendix D.

Approximately half of the sample is female. The average age is 37 years. By construction, the youngest participant is 18 years old and the oldest participant is 55 years old.[15] Level of education is summarized in the three categories: low, medium and high education.[16] 19.1% (26.5%) of the sample have a low (medium) level of education. The majority of the sample has achieved a high level of education (54.4%). Thus, the sample is slightly better educated than the average German population aged 18 to 55 years.[17]

*Additional variables*

The "Big Three" financial literacy questions (see Lusardi and Mitchell, 2011a) are used to approximate financial knowledge before the experiment. The three questions cover the topics of interest rate, inflation, and risk diversification and have been used extensively around the world (for an overview see, e.g., Lusardi and Mitchell, 2011b; Klapper *et al.*, 2015).[18] 78.5% of the participants are able to answer the question on the interest rate correctly. 75.5% and 60.9% are able to answer the question on inflation and risk diversification correctly, respectively. The share of "do not know" and "refuse to answer" responses steadily increases for these three questions (see Figure 7, Panel A). These patterns are in line with findings from other representative studies of the German population (see, e.g., Bucher-Koenen and Knebel, 2021; Bucher-Koenen *et al.*, 2023).On average, participants were able to answer 2.1 out of the three questions correctly. Approximately half of the participants can answer all three financial literacy questions correctly (48.3%). This is slightly lower than in other studies. Using the Panel of Household Finance from 2021 (PHF 2021), Bucher-Koenen *et al.* (2023) find that 61.8% of the German population can answer the "Big Three" financial literacy questions correctly. However, their sample consists of the financial decision-makers of each household.

[15] I restrict the sample according to age. Participants are excluded from the survey if they are younger than 18 years because they are not of legal age. Participants older than 55 years are also excluded because a time horizon of 20 years for an investment strategy might not be reasonable to this age group. This is enforced automatically with a screen out page at the beginning of the online questionnaire.

[16] Low education summarizes "No general school-leaving qualification" or "Secondary/elementary school with or without completed apprenticeship". Medium education contains "Secondary school, high school, technical school, commercial school without Abitur". High education summarizes "Abitur" and "completed degree (college or university)".

[17] On average, in the German adult population between 18-55 years, 22% have a low level of education, 31% a medium, and 47% a high level of education.

[18] The exact wording of the "Big Three" financial literacy questions can be found in Appendix D.

**Table 2: Summary statistics and randomization**

Table 2 contains the summary statistics and additional randomization tests. Columns 1 and 2 show the mean and standard deviation (sd) for the full sample, respectively. Columns 3 and 4 summarize the mean of the control group (neutral frame) and the treatment group (finance frame) in the framing treatment, respectively. Column 5 contains the difference between the treatment and the control group (Delta). Column 6 reports the T-statistic (T-stat) in parentheses indicating whether the delta is statistically significantly different from zero. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1. Columns 7 to 10 are defined analogously for the advice-giving treatment.

| | Full sample | | Neutral frame | Finance frame | Neutral vs finance frame | | No advice | Advice | No advice vs advice | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| | Mean | sd | mean | mean | Delta | T-stat | mean | mean | Delta | T-stat |
| ***Demographics*** | | | | | | | | | | |
| Female dummy | 0.523 | 0.5 | 0.514 | 0.532 | -0.017 | (-0.404) | 0.524 | 0.522 | 0.002 | (0.045) |
| Age in years | 37.0 | 10.7 | 36.536 | 37.493 | -0.956 | (-1.043) | 36.255 | 37.755 | -1.5 | (-1.638) |
| Household size | 2.697 | 1.385 | 2.757 | 2.634 | 0.123 | (1.036) | 2.83 | 2.564 | 0.266** | (2.250) |
| HH disposable income (in Euro), with non-response | | | | | | | | | | |
| Less than 2,000 Euro | 0.274 | 0.446 | 0.308 | 0.239 | 0.069* | (1.813) | 0.273 | 0.275 | -0.002 | (-0.043) |
| 2,000 to less than 3,500 Euro | 0.248 | 0.432 | 0.239 | 0.257 | -0.018 | (-0.494) | 0.207 | 0.289 | -0.083** | (-2.241) |
| 3,500 to less than 5,000 Euro | 0.211 | 0.409 | 0.174 | 0.25 | -0.076** | (-2.174) | 0.207 | 0.216 | -0.009 | (-0.270) |
| 5,000 Euro and more | 0.186 | 0.389 | 0.21 | 0.16 | 0.05 | (1.493) | 0.214 | 0.158 | 0.057* | (1.696) |
| Not specified | 0.081 | 0.273 | 0.069 | 0.093 | -0.024 | (-1.042) | 0.1 | 0.062 | 0.037 | (1.598) |
| Marital status | | | | | | | | | | |
| Single, living alone | 0.362 | 0.481 | 0.388 | 0.336 | 0.052 | (1.258) | 0.395 | 0.33 | 0.065 | (1.582) |
| Single, living together | 0.147 | 0.354 | 0.145 | 0.149 | -0.004 | (-0.142) | 0.111 | 0.183 | -0.072** | (-2.396) |
| Married, living together | 0.414 | 0.493 | 0.388 | 0.44 | -0.053 | (-1.245) | 0.428 | 0.399 | 0.029 | (0.68) |
| Div./separated/widowed, living alone | 0.061 | 0.239 | 0.062 | 0.06 | 0.002 | (0.092) | 0.052 | 0.07 | -0.018 | (-0.876) |
| Div./separated/widowed, living together | 0.017 | 0.128 | 0.018 | 0.015 | 0.003 | (0.292) | 0.015 | 0.018 | -0.004 | (-0.325) |
| Education dummy | | | | | | | | | | |
| Low | 0.191 | 0.394 | 0.188 | 0.194 | -0.006 | (-0.166) | 0.181 | 0.201 | -0.021 | (-0.612) |
| Medium | 0.265 | 0.442 | 0.268 | 0.261 | 0.007 | (0.183) | 0.229 | 0.3 | -0.072* | (-1.896) |
| High | 0.544 | 0.499 | 0.543 | 0.545 | -0.001 | (-0.030) | 0.59 | 0.498 | 0.092** | (2.165) |

**Table 2 (continued)**

| | (1) Full sample | | (2) Neutral frame | (3) Finance frame | (4) Neutral vs finance frame | | (5) No advice | (6) Advice | (7) No advice vs no advice | |
|---|---|---|---|---|---|---|---|---|---|---|
| | mean | sd | mean | mean | Delta | T-stat | mean | mean | Delta | T-stat |
| East dummy | 0.215 | 0.411 | 0.203 | 0.228 | -0.025 | (-0.700) | 0.221 | 0.209 | 0.013 | (0.357) |
| Observations | 544 | | 276 | 268 | 544 | | 271 | 273 | 544 | |
| ***Controls*** | | | | | | | | | | |
| "Big Three" financial literacy count (0-3) | 2.149 | 0.996 | 2.13 | 2.168 | -0.037 | (-0.438) | 2.107 | 2.19 | -0.083 | (-0.977) |
| "Big Three" correct (0/1) | 0.483 | 0.5 | 0.46 | 0.507 | -0.047 | (-1.103) | 0.472 | 0.495 | -0.022 | (-0.517) |
| FL1 Interest correct dummy | 0.785 | 0.411 | 0.779 | 0.791 | -0.012 | (-0.342) | 0.786 | 0.784 | 0.002 | (0.059) |
| FL2 Inflation correct dummy | 0.756 | 0.43 | 0.757 | 0.754 | 0.004 | (0.095) | 0.731 | 0.78 | -0.05 | (-1.345) |
| FL3 Risk diversification correct dummy | 0.608 | 0.489 | 0.594 | 0.623 | -0.029 | (-0.690) | 0.59 | 0.626 | -0.036 | (-0.858) |
| Conf. to make good fin. decisions bef. exp. (0-10) | 6.136 | 2.036 | 6.047 | 6.228 | -0.181 | (-1.035) | 6.236 | 6.037 | 0.2 | (1.144) |
| Stock ownership (0/1) | 0.401 | 0.49 | 0.417 | 0.384 | 0.032 | -0.769 | 0.424 | 0.377 | 0.047 | -1.119 |
| Bond ownership (0/1) | 0.16 | 0.367 | 0.174 | 0.146 | 0.028 | -0.903 | 0.173 | 0.147 | 0.027 | -0.855 |
| Risk tolerance (0-10) | 4.761 | 2.448 | 4.804 | 4.716 | 0.088 | (0.419) | 5.022 | 4.502 | 0.520** | (2.490) |
| Financial risk tolerance (0-10) | 3.785 | 2.653 | 3.793 | 3.776 | 0.017 | (0.076) | 3.974 | 3.597 | 0.377* | (1.660) |
| Observations | 544 | | 276 | 268 | 544 | | 271 | 273 | 544 | |

The average confidence in one's financial decision-making skills before the experiment is 6.1 on a scale from 0 meaning "no confidence" to 10 meaning "very high confidence". 40.1% of the participants own stocks and 16% own bonds. This is higher compared to the average German population. In 2023, 17.6% of Germans aged 14 and older owned stocks (DAI, 2024). Both general and financial risk tolerance are surveyed. While participants are more willing to accept general risk (mean of 4.8, on a scale from 0 to 10), they are more hesitant to accept financial risk (mean of 3.8, on a scale from 0 to 10).

*Randomization*

Table 2 shows the randomization test of the main characteristics in both the framing treatment (Columns 3 to 6) and the advice-giving treatment (Columns 7 to 10). Overall, the randomization into the two treatments was successful. However, participants who were asked to give advice are slightly more risk averse than those who did not give advice. This is the case for both general risk aversion and financial risk aversion. On a scale from 0 meaning "Not at all willing to take risk" to 10 meaning "Very willing to take risk", participants giving advice indicate a score of 4.5 on average. Participants not giving advice indicate an average score of 5.0. While the difference of 0.5 between the two groups is statistically significant, it is not economically meaningful. Furthermore, there are slight differences with regard to household size, household disposable income, marital status, and level of education between the control group that does not give advice and the treatment group that is asked to give advice. Again, however, the differences are economically negligible.

### 3.3. Definition of dependent variables and hypotheses

*Financial knowledge*

To track learning effects due to the usage of the simulation tool in the finance frame, I measure financial knowledge both before and after participants use the tool. Since the questions are asked within a short amount of time, the financial literacy questions before and after the experiment differ to avoid confusion and survey fatigue. I ask the "Big Three" financial literacy questions before the participants are introduced to the tool (see Lusardi and Mitchell, 2011a). After the experiment, participants are asked three more advanced financial literacy questions[19]:

*FL4: What is the main function of the stock market? [The stock market helps to predict share profits/ The stock market leads to an increase in share prices/* ***The stock market brings buyers and sellers of shares together****/ None of these/ Do not know/ Refuse to answer]*[20]

[19] FL4 and FL5 are taken from the Socio-Economic Panel Innovation Sample of the year 2018 (SOEP-IS 2018, SOEP-IS Group, 2020). FL6 on the comprehension of risk was first introduced by Lusardi *et al.* (2017) in the *TIAA Institute-GFLEC Personal Finance Index* (P-Fin Index).
[20] The correct answers are printed in bold.

*FL5: Which of the following investment forms has the highest volatility of returns? [Savings accounts/ Fixed-term deposits/ Fixed-interest securities/* ***Shares****/ Do not know/ Refuse to answer]*

*FL6: There's a 50/50 chance that Malik's car will need engine repairs within the next six months which would cost 1,000 Euro. At the same time there is a 10% chance that he will need to replace the air conditioning unit in his house, which would cost 4,000 Euro. Which poses the greater financial risk for Malik? [****The car repair****/ The air conditioning replacement/ There is no way to tell in advance/ Do not know/ Refuse to answer]*

It is important to note that only FL5 on the volatility of returns is directly related to knowledge that can be acquired when using the simulation tool in the finance frame. On the one hand, when clicking through the introductory slides, the participants in the finance frame treatment receive the information that, on average, returns and the total value of the assets saved can fluctuate more in the risky assets than in the risk-free assets. On the other hand, the interactive graph visualizes the volatility by showing different investment scenarios. Hence, there might be learning with regard to this particular question. FL4 and FL6 are unrelated to the tool's content. Hence, I test Hypothesis 1:

***H1:*** *Participants in the finance frame are more likely to answer question FL5 correctly than those in the neutral frame. The other financial literacy questions (FL4 and FL6) are not affected.*

When participants give financial advice, they do not acquire additional (new) information. Hence, learning is purely driven by the use of the simulation tool in the finance frame. Here, I test Hypothesis 2:

***H2:*** *The advice-giving task does not directly influence financial knowledge.*

In addition, I collect a subjective measure of financial knowledge, i.e., *self-assessed financial literacy (0-6)* to control for potential measurement error.[21] Participants are asked to assess how many of the six questions they were able to answer correctly. Thus, the scale is from 0 to 6 with the additional answer options "do not know" and "refuse to answer".

*Confidence*

To assess changes in confidence during the survey, participants face the following direct confidence question both before and after the experiment (including the simulation tool in different frames and the advice-giving treatment)[22]:

*"How much confidence do you have in your ability to make good financial decisions?" (Scale: 0 meaning "no confidence" to 10 meaning "very high confidence")*

[21] In the literature, *self-assessed financial literacy* is sometimes also used to proxy confidence in financial decision-making abilities (e.g., Kramer, 2016; Finke *et al.*, 2017).
[22] See Figure 1 for details on the survey design.

I also calculate the difference in confidence (defined as the confidence score after minus the confidence score before the experiment) and create dummies for both an increase and a decrease in the confidence score during the experiment.

To control for measurement error, three indirect confidence measures are collected after the experiment. I use the following statements where the answer scale is defined from 0 meaning "fully disagree" to 10 meaning "fully agree":

- *"I have the confidence to participate in the stock market."*
- *"I am afraid of investing money or making financial decisions."*
- *"I would never participate in the stock market without my advisor."*

Furthermore, the number of "do not know" responses to the financial literacy questions have been used as a proxy for confidence (e.g., Bucher-Koenen *et al.*, 2025a). In my setting, I am able to assess the number of "do not know" responses to the financial literacy questions both before and after the experiment. I use the latter as a proxy for confidence which is measured as a score ranging from 0 to 3.

The psychology literature shows that giving advice can boost confidence (Eskreis-Winkler *et al.*, 2018, 2019). I apply this approach in a financial setting and test Hypothesis 3:

***H3:*** *Participants who are asked to give financial advice become more confident in their financial decision-making skills than those who are not.*

Just using the simulation tool in the finance frame might affect confidence positively as well. Here, Jha and Shayo (2024) find that trading stocks for four to seven weeks without additional education or learning material leads to higher stock market participation, higher subjective and objective confidence, as well as higher risk tolerance. I test Hypothesis 4:

***H4:*** *Participants are more confident in their financial decision-making skills after using the simulation tool in the finance frame than in the neutral frame.*

*Motivation*

Managing one's finances is a lifelong task and a learning process. Hence, it is important to be motivated and to stay motivated to deal with one's personal finances. With the design of the simulation tool, I aim to stimulate participants to continue thinking about their finances and topics related to finance. In the questionnaire, I implement two measures to capture motivation:

*Direct: "How motivated are you to [further] deal with the topic of "saving and investing"?" (Scale: 0 meaning "not motivated at all" to 10 meaning "very strongly motivated")*

*Indirect: "Thank you for taking part in our survey! As a thank you, we offer you the opportunity to download one of these three resources free of charge." [E-book on investing; ZEW expert brief on COVID-crisis; Link to consumer advice center; No, thank you]*

I introduce the direct measure of motivation immediately after the experiment to capture the instant reaction to the simulation tool and the advice-giving task. The indirect measure is implemented at the very end of the questionnaire. Participants have the opportunity to download a document related to further learning about finance at the end of the survey. They can choose between i) the E-book "Genial einfach investieren (English: Ingeniously simple investing)" by Prof. Martin Weber, ii) a ZEW expert brief on how the coronavirus crisis and price increases affected pension provision, and iii) a link to the consumer advice center webpage with an overview on the topic "Everything you need to know about investing". I define a download dummy equal to 0 if there was no download, 1 if the participant downloaded one of the three documents. Here, I aim to capture a rather forward-looking channel. A change in overall motivation can be tentative evidence of future changes in investment or saving behavior.

Eskreis-Winkler *et al.* (2018, 2019) find that the students are more confident after giving advice to others which also translates into more motivation with regard to their own performance. Moreover, Wang (2023) shows that the usage of a financial simulation game increases learning motivation among finance students. Hence, I test Hypotheses 5 and 6:

***H5:*** *Participants who give financial advice are more motivated to deal with the topic of "saving and investing" and are more likely to consult additional material than those who did not.*

***H6:*** *Participants allocated to the finance frame treatment are more motivated to deal with the topic of "saving and investing" and are more likely to consult additional material than those allocated to the neutral frame treatment.*

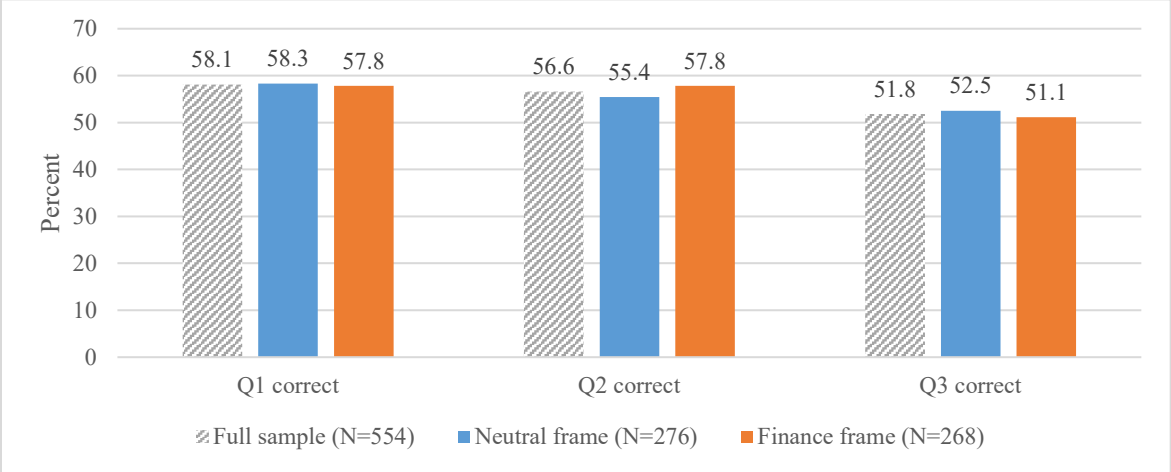
## 4. Evaluation of the simulation tool and the advice-giving task

### 4.1. Do participants understand the simulation tool?

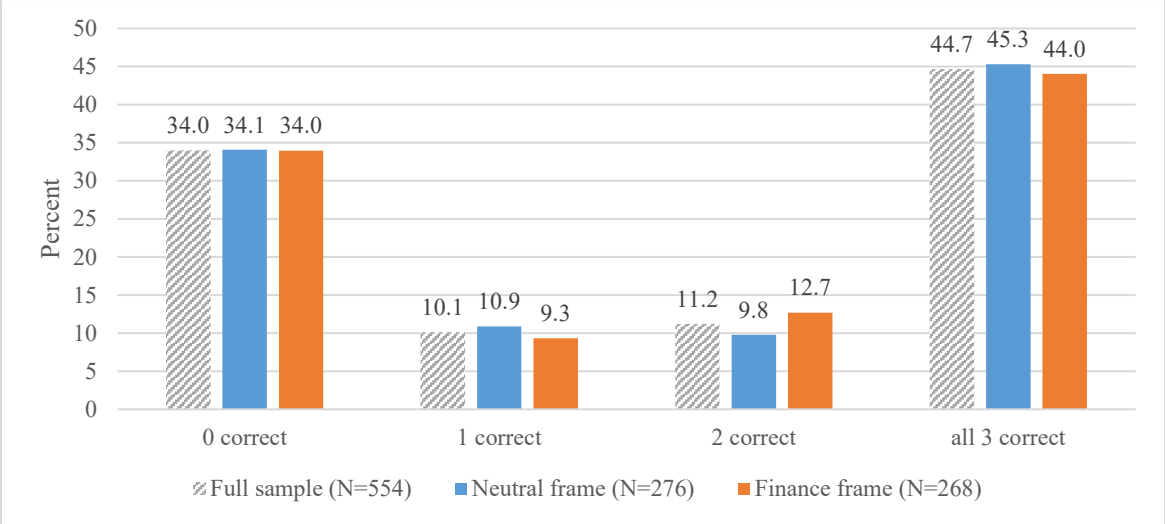
To assess whether the participants are able to understand the simulation tool, three comprehension questions are implemented after the participants see the simulation tool (see Figure 3, Step 4). In the first comprehension question (Q1), participants are asked to read a value off the interactive graph – no further adjustments in the tool are necessary to answer the comprehension question. Comprehension questions 2 and 3 are slightly more difficult. To answer Q2, participants are asked to adjust the share of risky assets/ trees. In Q3, they have to adjust the monthly savings amount/ number of trees and read off a value from the interactive graph. It required a maximum of three clicks to get to the correct adjustment, respectively. The exact wording of the comprehension questions can be found in Appendix D.

**Figure 4: Comprehension questions**

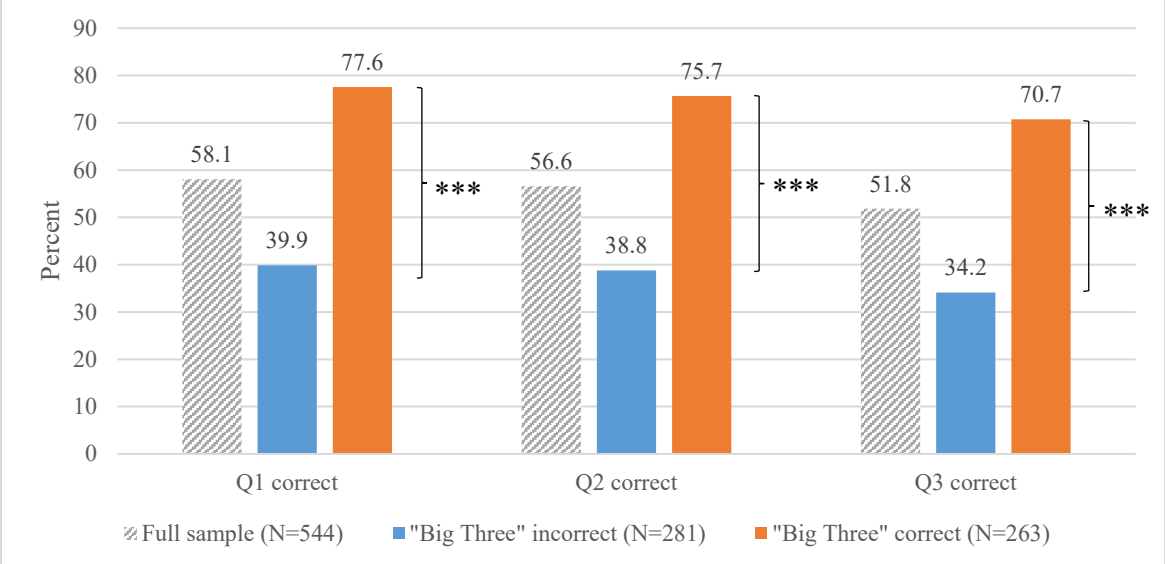
**Panel A:** Correct answers to the three comprehension questions by framing treatment



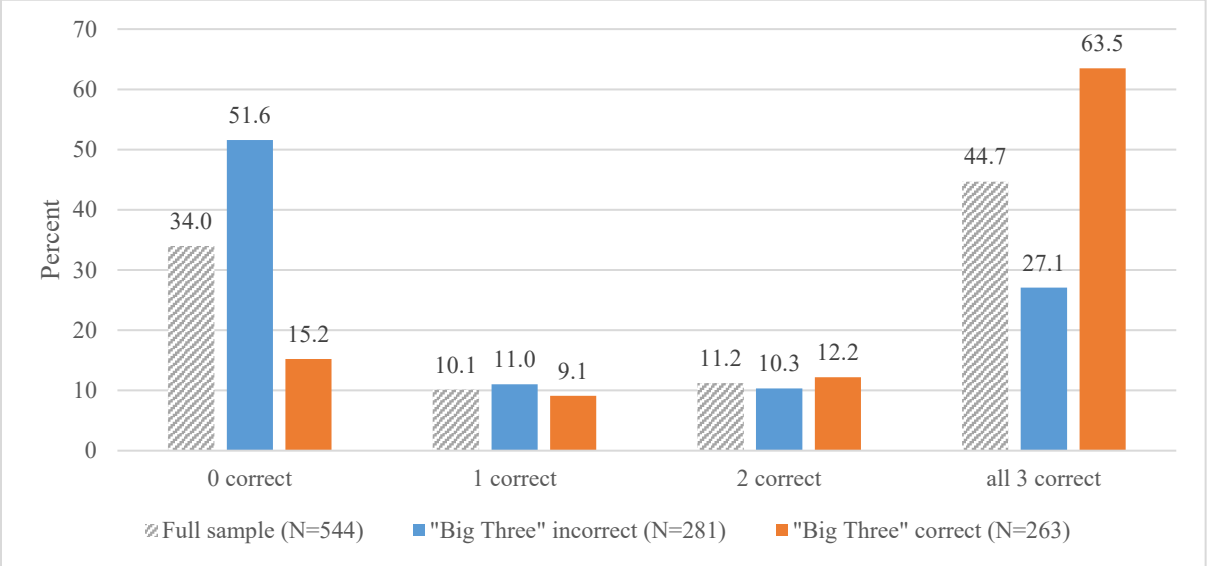

**Panel B:** Number of correct answers to comprehension questions (score) by framing treatment




**Panel C:** Correct answers to each comprehension questions by "Big Three" dummy



**Panel D:** Number of correct answers to comprehension questions (score) by "Big Three" dummy




Notes: Figure 4 provides an overview of the three comprehension questions asked after using the simulation tool. Panel A shows the results for each question separately differentiating between neutral and finance frame (framing treatment). Panel B shows the cumulative results by framing treatment. Panel C and D provide an overview of the three comprehension questions by financial literacy. Financial literacy is captured by the "Big Three" dummy equaling 1 if the individual is able to answer all three basic financial literacy questions implemented before the simulation tool in the survey correctly, 0 otherwise. Panel A shows the results for each question separately by financial literacy. Panel B shows the cumulative results by financial literacy. T-tests are used to test differences between groups. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1. N=544.

Figure 4, Panel A shows the share of correct answers for each of the three comprehension questions by the framing of the treatment. Overall, 58.1% of the participants are able to answer the first comprehension question correctly. There is no difference between the neutral frame and the finance frame.[23] The share of correct answers slightly decreases for comprehension questions 2 and 3 (56.6% and 51.8% correct answers respectively) corresponding to the increase in question difficulty. Again the differences in means between the neutral frame and the finance frame are not statistically significant.[24] This suggests that participants are equally likely to understand the tool independent of the framing treatment.

In Figure 4, Panel B the cumulative results for the comprehension questions are shown. 34.0% of the participants in the full sample are not able to answer any of the three comprehension questions correctly.[25] 10.1% (11.2%) of the participants are able to answer one (two) comprehension question(s)

[23] A t-test is used to test whether the means of the neutral frame and the finance frame are equal. t-test for Q1: Pr(|T|>|t|) = 0.9066

[24] t-test for Q2: Pr(|T| > |t|) = 0.5730 and for Q3: Pr(|T| > |t|) = 0.7415

[25] Overall, 3% of the participants give the same (wrong) answer to all three comprehension questions, e.g., they provide the same numerical value to all questions. Interestingly, they are evenly distributed among financial literacy levels (as measured by the "Big Three" count variable) (results not shown).

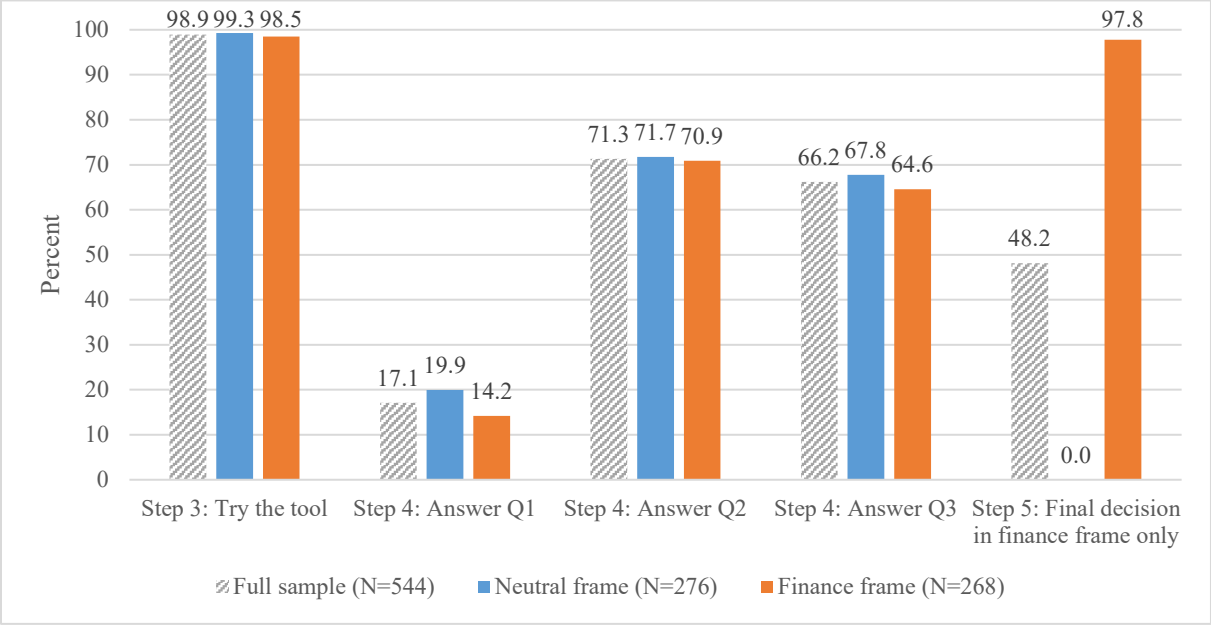
correctly. 44.7% of the participants are able to answer all three questions correctly. Hence, these findings suggest that participants either understand the tool (and are able to answer all three comprehension questions correctly) or not (and give no correct answers). A $\chi^2$-test shows that differences in distribution between the neutral frame and the finance frame are not statistically significant (Pearson chi2(3) = 1.3908; Pr = 0.708).

Furthermore, prior financial knowledge as measured by the "Big Three" financial literacy questions before the experiment is crucial for understanding the tool. Figure 4, Panel C shows that participants who answer the "Big Three" questions correctly, are more likely to answer each of the three comprehension questions correctly compared to those who are not able to answer the "Big Three" correctly. A similar picture emerges for the cumulative results (see Figure 4, Panel D).

These findings emphasize how important it is to set up a simulation tool which is concise and easily understandable – no matter the framing. It is particularly important given the widespread use of simulation tools by online brokers which are even more complex than the current design. Especially those with low financial knowledge struggle to comprehend this simplified simulation tool. Their need for additional support should also be taken into consideration.

How participants behave when using the tool is an interesting aspect to better understand challenges individuals might face. Here, the clicking behavior can yield useful insights especially with regard to the three comprehension questions. Figure 5 summarizes participants' clicking behavior. Throughout the experimental flow in the simulation tool, participants had the opportunity to explore the tool themselves. In Step 3 (see Figure 3 for details), participants could try the tool themselves for the first time. They could only proceed if they adjusted at least one value within the interactive graph. Accordingly, 99% clicked at least once at this stage of the experiment. Step 4 consists of three comprehension questions. For Q1, it was not necessary to adjust a value. Participants were asked to read a value directly off the interactive graph without adjusting a value. Nevertheless, 17.1% of the participants clicked at least once. For Q2, participants were asked to adjust the share of risky assets/ trees. For Q3, the savings amount/ number of trees had to be adjusted. For these two questions, the share of participants who actively used the tool is much higher (71.3% and 66.2%, respectively). This behavior is also reflected in the percentage of correct answers to the comprehension questions. In Step 5, participants in the finance frame were asked to choose a value for themselves. Interestingly, now 97.8% of the participants interact with the simulation tool. Overall, one participant (i.e., 0.18% of the sample) never clicks to adjust a value in Steps 3 to 5 of the simulation tool, 11.2% of the participants click only once. The number of steps in which participants click is positively correlated with the number of correct answers (correlation coefficient of 0.59).

**Figure 5: Clicking behavior when using the simulation tool**




Notes: Figure 5 shows the percentage of participants who adjust at least once a value in the simulation tool for each step during the experiment. N=544.

After each comprehension question, participants are asked how confident they are that they have answered the question correctly. It becomes evident that participants are able to accurately assess their ability to answer the questions correctly (see Table A1). For example, 81.7% of the participants who answered the first comprehension question correctly indicated that they are "very sure" that their answer is correct, while only 6.0% are "not sure". The reverse holds true for the participants who answered the first question incorrectly. Here, the distribution is more evenly spread. Only 27.2% are "very sure" and 44.7% are "not sure" to have given the correct answer. The pattern is similar for comprehension questions 2 and 3.

Furthermore, the participants are asked to give feedback regarding their experiences with the simulation tool (see Figure 3, Step 6). Figure A2 shows the mean results by the framing of the treatment. On average, participants find the graph very comprehensive (mean score of 7.2 on a scale from 0 to 10), helpful (means score of 7.3), and informative (mean score of 6.8). Furthermore, participants indicate that they perceived the graph not to be complex (mean score of 3.7). There is no difference in assessment between the tool in the neutral and the finance frame.[26] These findings are in line with the earlier results showing that the majority of participants in general understands the tool and assesses it positively.

Additionally, participants in the finance frame are asked: *"Please think about your own financial situation. Which values would you choose for yourself in the interactive graph?"* (see Figure 3, Step

[26] t-test for comprehensibility: Pr(|T| > |t|) = 0.8972; Helpfulness: Pr(|T| > |t|) = 0.5392; Complexity: Pr(|T| > |t|) = 0.6624; Informativeness: Pr(|T| > |t|) = 0.3585

5).[27] Figure A3, Panel A shows the monthly savings amount participants choose for themselves by tool comprehension. In the full sample, approximately one quarter of the participants (26.5%) would choose a monthly savings amount lower than 100 Euro. 48.5% select a monthly savings amount between 100 Euro and below 200 Euro. 25.0% indicated that they would save more than 200 Euro every month. Those who answer all three comprehension questions incorrectly indicate much lower savings amounts than those who give one or more correct answers.[28] In the long term, this has a major impact on accumulated assets after 20 years. Figure A3, Panel B summarizes the share of risky assets in the portfolio participants chose by their financial risk tolerance. The majority of the participants is willing to accept a share of risky assets of 50% in their portfolio. Approximately one third chooses a lower share of risky assets and one quarter accepts a higher share of risky assets. The highest risk categories, i.e., share of risky assets of 90% and 100%, are chosen very rarely. This shows that participants read the instructions in the slide show and follow the suggestion not to pick the two highest risk categories. Furthermore, participants choose the share of risky assets in accordance with their financial risk preferences.[29]

Overall, participants understand the simulation tool and take it seriously irrespective of the frame in which it is presented. Importantly, however, one third of the participants is not able to answer any of the three comprehension questions correctly. Here, prior financial literacy is an important prerequisite. This gives rise to further considerations about the design and implementation of such simulation tools in the future. In the empirical analyses, understanding the simulation tool is a crucial condition for a successful framing treatment and is taken into account in subgroup analyses.

### 4.2. Do participants take the advice-task seriously and do they give reasonable advice?

The advice-giving task consists of two parts. First, participants are asked in an open field format to give tips to a friend when it comes to saving for retirement. Figure 6, Panel A shows the results by framing treatment. Entries are coded manually into 15 categories.

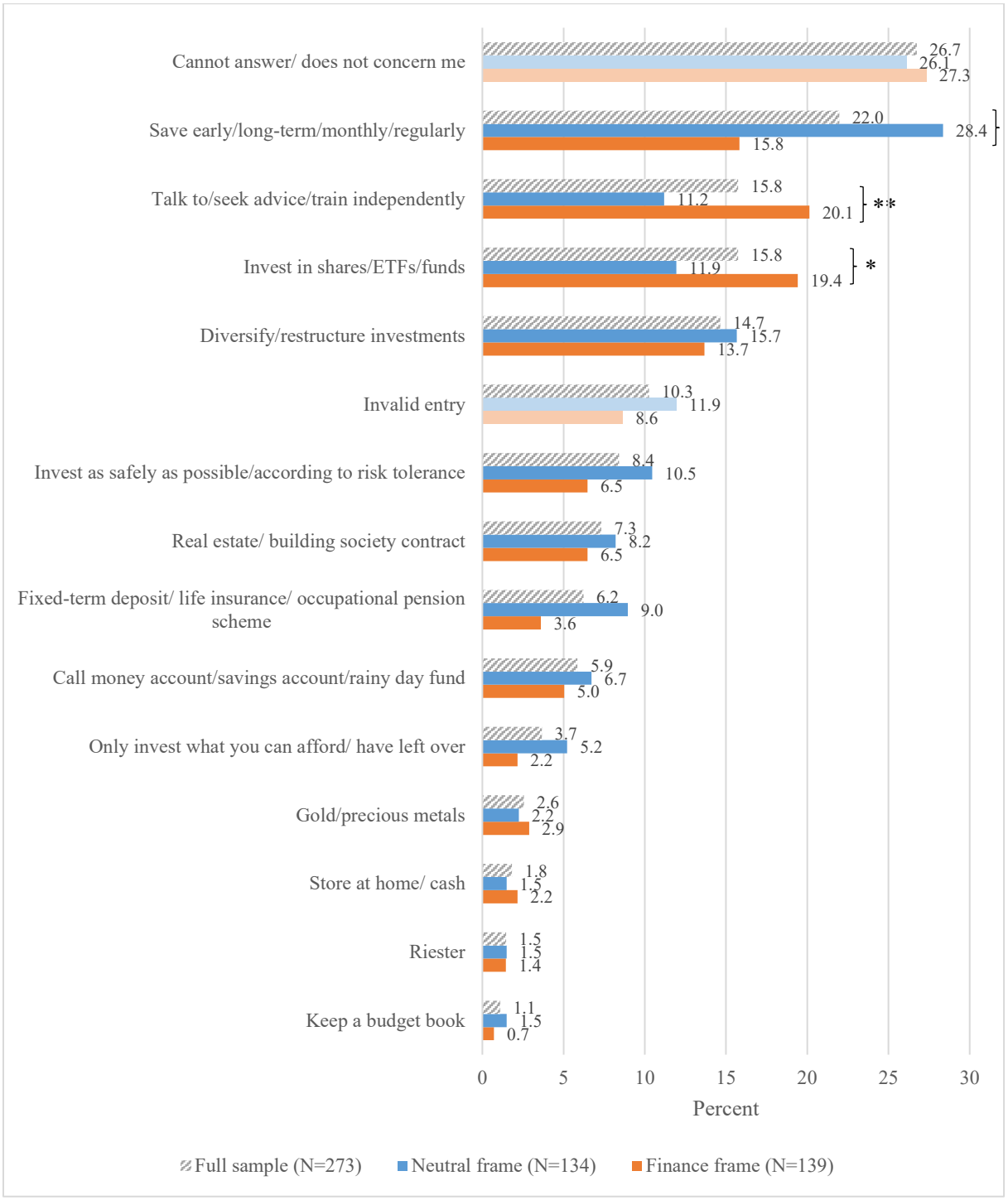
[27] Participants in the neutral frame are not asked to make a choice for themselves and, hence, are excluded from the analysis.

[28] The middle category "100-149 Euro" contains the default setting of 100 Euro for the monthly savings amount. In the full sample, 14.5% of the participants selected exactly 100 Euros as their preferred savings amount or do not change the default setting. The percentage is comparable when looking at those who answer all three comprehension question wrongly (15.4%) and those who answer one to three comprehension questions correctly (14.1%).

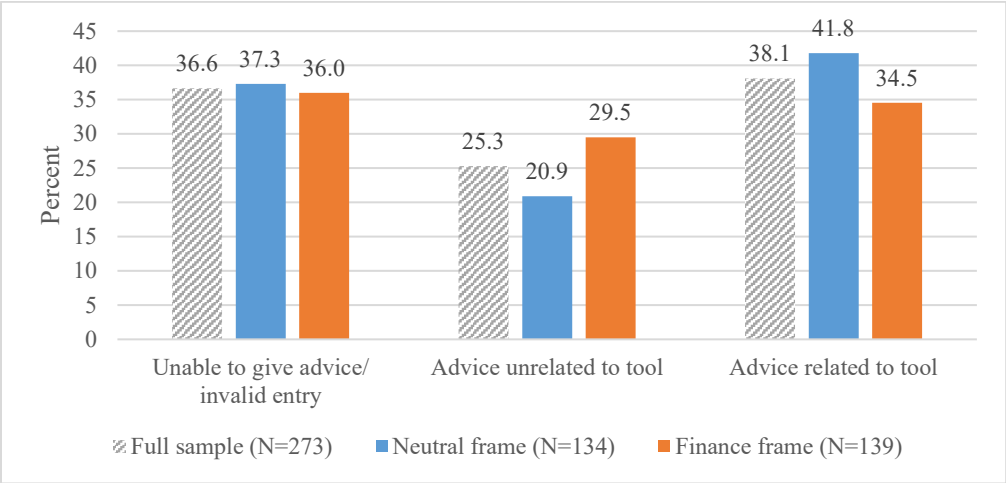
[29] The difference in distributions of the three values of the financial risk tolerance dummy is statistically significant. $\chi^2$-test: Pearson chi2(20) = 49.9156, Pr = 0.000

**Figure 6: Advice-giving task (open field question)**

**Panel A:** Advice-giving task (open field question) by framing treatment – all categories



**Panel B:** Advice-giving task (open field question) by framing treatment – related to tool




Notes: Figure 6 shows the answers to the open-field advice-giving task. The original question reads: *"What tips would you give a friend when it comes to saving for retirement? Please describe your advice in a few short sentences or bullet points."* [Open field] The answers were coded manually into 15 categories. Panel A shows the results for all 15 categories by framing treatment. In Panel B, the answers are summarized into three categories: i) unable to give advice/ invalid entry, ii) advice unrelated to the tool's content, and iii) advice related to the tool's content. T-tests are used to test differences between groups. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1. N=273.

26.7% of the participants feel unable to provide adequate financial advice, which is summarized in the category "cannot answer/ does not concern me". It is encouraging to see that participants are honest about it and still took the task seriously. In contrast, 10.3% of the participants give invalid answers indicating that they are not committed to the advice-giving task.[30] The most frequent advice focusses on saving behavior, e.g., starting to save early, saving regularly and over a long time horizon (22.0%). Interestingly, participants seeing the simulation tool in the neutral frame are more likely to give this advice (28.4%) than those in the finance frame (15.8%). The difference is statistically different from zero.[31] Moreover, participants often recommended to seek advice from an advisor or to train independently (15.8%) and to invest in shares or ETFs (15.8%). Here, participants in the finance frame are more likely to give this advice (seek advice from advisor: 20.1%; invest in shares or ETFs: 19.4%) than those in the neutral frame (seek advice from advisor: 11.2%; invest in shares or ETFs: 11.9%).[32] This might reflect that participants in the finance frame think more prominently about appropriate investment strategies and not necessarily about the amount of money invested. Less frequently given advice refers, for example, to diversifying or restructuring one's investments (14.7%) and investing safely or according one's risk preferences (8.4%).

[30] Examples for such answers are "dfasdfasdfas", "fits", "Jo", or "good". There is no difference in means between the neutral frame and the finance frame. T-test: Pr(|T| > |t|) = 0.8209
[31] T-test: Pr(|T| > |t|) = 0.0123
[32] The difference in means is statistically significantly different from zero. T-test for "seek advice": Pr(|T| > |t|) = 0.0426; T-test for "invest in ETFs": Pr(|T| > |t|) = 0.0903

Figure 6, Panel B shows the results in a more condensed form. The 15 answer categories are summarized in three groups. Group 1 consists of those who are unable to give advice or give invalid advice. Group 2 consists of participants giving advice unrelated to the tool's content.[33] Group 3 consists of participants giving advice related to the tool's content, .i.e., the three categories "save early/ regularly", "invest in stocks/ ETFs", and "diversify". Since multiple entries were possible, if one of the topics mentioned relates to the tool, it counts toward this category. This analysis shows that one quarter of the advice is unrelated (25.3%) and 38.1% is related to the tool's content. While the overall distribution does not differ significantly between the neutral frame and the finance frame, participants in the finance frame are more likely to give unrelated advice (29.5%) than those in the neutral frame (20.9%). This is an interesting result because it indicates that participants in the finance frame think more broadly about financial advice they can give.

Second, three closed form questions capture recommendations for investing in the capital market, saving for old-age directly after entering into working life, and seeking professional financial advice. Figure A4 summarizes the mean results by framing treatment. Concerning the advice to invest in the capital market, the participants seem undecided. They indicate an average score of 5.0 (on a scale from 0 to 10). There is no difference between the finance frame and the neutral frame. Interestingly, participants would recommend to start saving for old age as early as the beginning of one's working life (mean score of 7.1 on a scale from 0 to 10) and would advise a friend without experience to seek professional financial advice (mean score of 6.7 on a scale from 0 to 10). Again, the difference in means between the two frames is not statistically significant (t-test not shown).

Overall, the findings from both the open field and closed form questions show that the participants took the advice-giving task seriously even though they might not feel confident or skilled enough to give financial advice. Only approximately 10% of answers are invalid. In the empirical analyses, giving proper advice, i.e., excluding "invalid advice" and "unable to give advice", is a crucial condition for a successful advice giving treatment and is taken into account in subgroup analyses.

[33] Group 2 summarizes the following ten categories: "talk to/ seek advice", "risk tolerance", "real estate", "occupational pensions", "rainy day fund", "invest what you can afford", "gold", "cash", "Riester", and "budget book".

## 5. Results

### 5.1. Empirical strategy[34]

*Main specification*

First, to better understand the framing treatment and the advice-giving treatment separately, the following baseline ordinary least squares (OLS) model is estimated using Equation 1:

$$outcome\ variable = \alpha + \beta_1 framing\ treatment + \beta_2 advice\ treatment + \gamma X + \varepsilon \quad (1)$$

The *outcome variable* represents the different definitions of *financial knowledge*, *confidence*, and *motivation*, respectively. The independent variable *framing treatment* is a dummy equaling 1 if the participant sees the simulation tool in the finance frame, and 0 if he or she sees it in the neutral frame. The variable *advice-giving treatment* is a dummy equaling 1 if the participant is asked to give hypothetical financial advice during the survey, 0 if this is not the case. *X* summarizes the control variables and includes a *female* dummy, *age (in years)*, *risk tolerance (0-10)*, *household disposable income*, *education* (low, medium, high dummy), *confidence before the tool (0-10)*, a dummy for *"Big Three" correct*, and an *East dummy*, indicating whether the individual currently lives in former East or West Germany. $\varepsilon$ is the error term. The definitions of all variables are summarized in Appendix D.

Three direct measures of *financial knowledge* are implemented: One dummy for each of the three advanced financial literacy questions. It equals 1 if the participant is able to answer the respective financial literacy questions correctly, 0 otherwise. To show that the learning effect is purely driven by FL5 on the volatility of returns, I define two additional dummies that equal 1 if the participants is able to answer i) at least one of FL4 and FL6 correctly and ii) both FL4 and FL6 correctly and implement them as outcome variables. As a robustness check, I define *FL score (0-3, after)* as a score accumulating the number of correct answers to the three advanced financial literacy questions. The score ranges accordingly from 0 to 3 correct answers. Furthermore, I use the self-assessed financial literacy score (*Self-assessed FL (0-6)*) as a proxy for subjective financial knowledge.

*Confidence after the experiment (0-10)* is defined on a scale from 0 meaning "no confidence in own ability" to 10 meaning "high confidence in own ability". Alternatively, it is defined as the score of "do not know" responses to the three advanced financial literacy questions (*# DNK after (0-3)*). As further robustness checks, the three statements described in Section 3.3 are included as dependent variables (shorted to *Conf. SMP*, *Fear investing*, and *w/o advisor no SMP*, respectively). Finally, the difference in confidence as well as a dummy for an increase and a decrease in confidence are used as dependent variable in the regression analyses.

[34] In the pre-analysis plan, one part of the analysis focused on the heterogeneity by gender. Due to the small sample size, however, I will not include this analysis in the paper. Furthermore, the open field responses to the general risk question ("What did you have in mind when you answered the question about the general risk?") will not be analyzed in this version of the paper.

The main definition of *motivation* is the direct measure defined on a scale from 0 meaning "not motivated at all" to 10 meaning "very strongly motivated" (*Motivation (direct, 0-10)*). Further, I include the indirect measure of motivation. This dummy variable equals 1 if the participant downloaded one of the three supplementary materials at the end of the survey, 0 if there was no download (*Motivation (indirect, download 0/1)*).

*Interaction effect of framing and advice-giving treatment*

Due to the 2x2 between-subjects design, it is possible to account for interaction effects between the two treatments. Equation (2) estimates an ordinary least squares (OLS) model including the interaction effect between the framing treatment and the advice-giving treatment:

$$outcome\ variable = \alpha + \beta_1 framing\ tr. + \beta_2 advice\ tr. + \beta_3 framing\ tr. * advice\ tr. + \gamma X + \varepsilon \quad (2)$$

*X* summarizes the same control variables as described in Equation 1. $\varepsilon$ is the error term.

### 5.2. Financial knowledge

*Descriptive results*

Figure 7, Panel A depicts the share of correct answers to all six financial literacy questions and the share of "do not know/ refuse to answer" responses.[35] It shows that the "Big Three" asked before the experiment are indeed easier than the more advanced financial literacy questions implemented after the experiment.

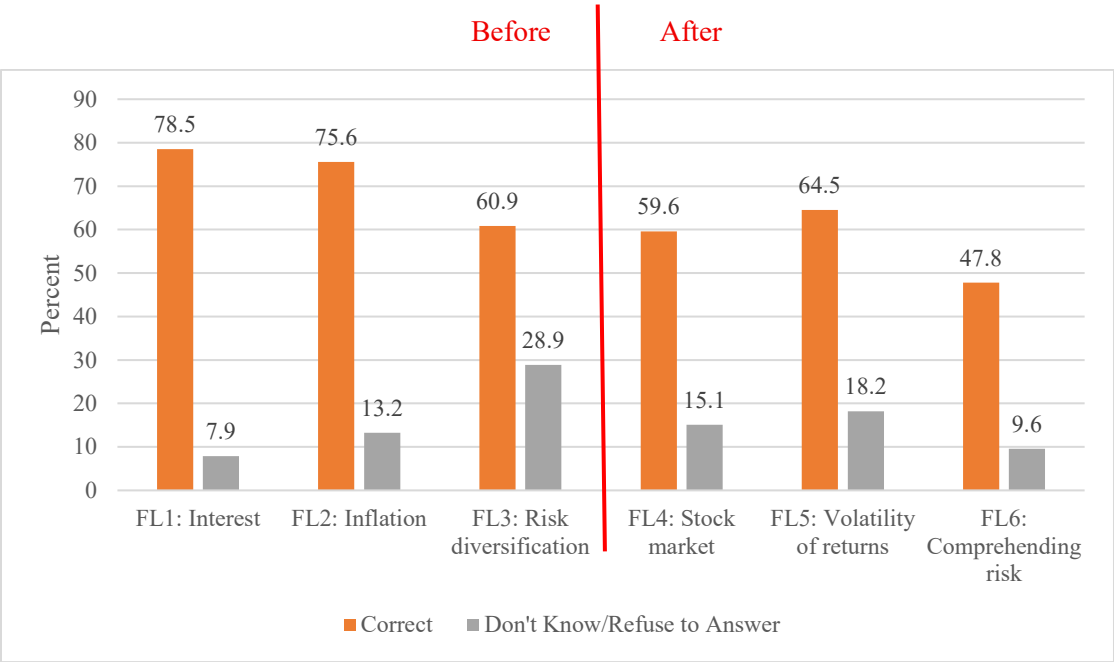
59.6% of the participants were able to answer the stock market question correctly. Interestingly, a slightly higher share of participants (64.5%) is able to answer the question on volatility of returns correctly. At the same time, however, the share of "do not know/ refuse to answer" also increases to 18.2%.[36] Less than half of the sample (47.8%) is able to answer the question on comprehending risk correctly. The share of "do not know/ refuse to answer" responses is the lowest (9.6%) among the questions posed after the experiment.[37]

The question on the volatility of returns of different asset classes is closely related to the simulation tool in the finance frame. Figure 7, Panel B shows the descriptive results for this question separately for both the framing and the advice-giving treatment. Participants in the finance frame are more likely to answer

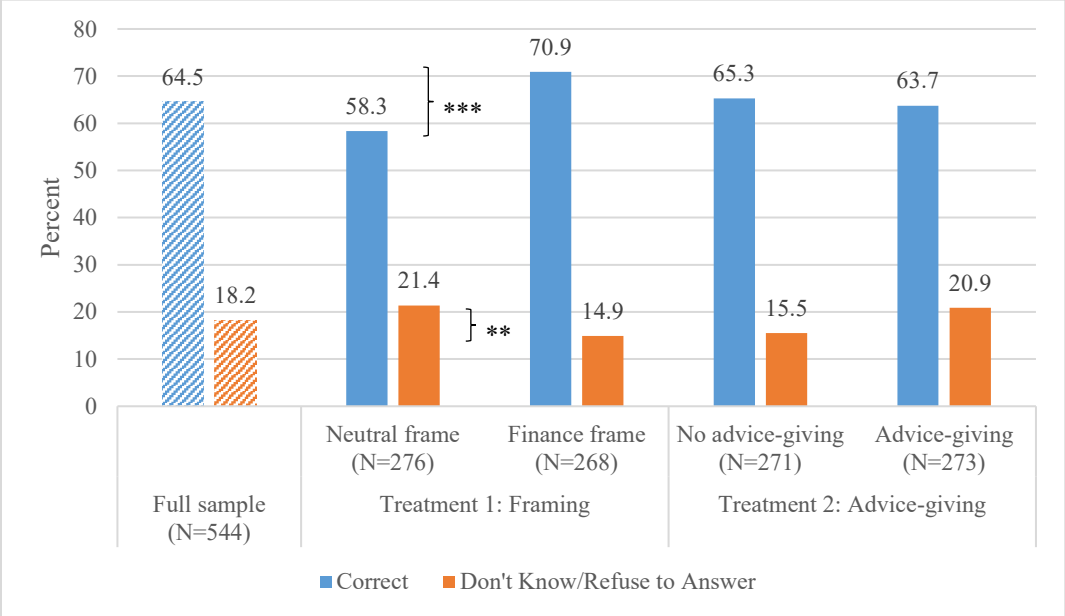
[35] The results for all six financial literacy questions individually can be found in Table A2.
[36] Breunig *et al.* (2021) analyze the answers of N=690 household heads in the SOEP sample and find that, on average, 84% of the respondents are able to answer the volatility question correctly. Since a household head is the person most familiar with the household's financial matters, it is not surprising that the share of correct answers is lower in the sample of this study.
[37] For a representative sample of the U.S. population, Yakoboski *et al.* (2022) find that only 36% of Americans are able to give the correct answer to the risk comprehension question. In 2017, the share was slightly higher at 39%. Surprisingly, the share of "do not know" responses is as high as 20% in 2017 (Lusardi *et al.*, 2017). That is more than twice as high as in the German sample of this study.

**Figure 7: Financial literacy**

**Panel A:** Financial literacy questions before and after the experiment




**Panel B:** FL5 Volatility of returns by framing treatment and advice-giving treatment




Notes: Figure 7, Panel A shows the results for the financial literacy questions asked throughout the survey. FL1 to 3 capture basic financial literacy and are implemented before the experiment. FL4 to 6 capture advanced financial literacy and are implemented after the experiment. Panel B shows the results for FL5 by framing treatment and by advice-giving treatment separately. N=544. T-tests are used to test differences between groups. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

this question correctly (70.9%) compared to those in the neutral frame (58.3%). The difference is statistically significant on the 1% level. This is a first indication in favor of Hypothesis 1 that participants learn when using the investment simulation tool. The advice-giving treatment does not influence the response patterns – neither for the share of correct answers nor for the share of "do not know/ refuse to answer" responses. This indicates that giving financial advice per se does not increase financial knowledge which is line with Hypothesis 2.

*Regression results*

Table 3 shows the OLS regression results for the main specification (Equation 1) of financial knowledge using FL4, FL5, and FL6 as dependent variables, respectively.

In line with the descriptive evidence, I find that participants seeing the simulation tool in the finance frame are 12.6 p.p. more likely to answer the financial literacy question FL5 on volatility of returns correctly than those in the neutral frame. The coefficient is statistically significant on the 1% level (Column 3). When including controls, the effect remains statistically significant with the standard errors becoming smaller (Column 4). This speaks in favor of a successful randomization of the treatments. The framing treatment does not have a significant positive effect on the likelihood to answer the question on the purpose of the stock market (FL4) correctly (Columns 1 and 2). Columns 5 and 6 contain the results for the financial literacy question on the comprehension of risk (FL6). Here, participants seeing the simulation tool in the finance frame are approximately 7 p.p. less likely to answer FL6 correctly. The effect is statistically significant on the 10% level and stays significant when including controls. Thus, there is only learning when the question is closely linked to the tool's content which is in line with Hypothesis 1. Overall, the advice-giving task does not influence the likelihood of answering any of the financial literacy questions correctly, confirming Hypothesis 2.[38] However, participants who were asked to give advice are less likely to answer FL6 correctly compared to those not giving advice. The effect becomes insignificant when including controls. A look at the control variables reveals that older participants, those with medium or high education level (compared to low education level), and a priori more confident participants are more likely to answer the advanced financial literacy questions correctly. Participants with higher risk tolerance are slightly less likely to give the correct answer. Interestingly, while higher initial financial knowledge (as measured by *"Big Three" correct*) has a strong positive effect on answering FL4 and FL5 correctly, it is insignificant for FL6.

The results for FL6 are puzzling at first glance. They are in contrast to the results for FL5 and do not fit the reasoning that there is no learning for financial literacy questions unrelated to the tool's content. Table A3 contains the correlations between FL6 and other relevant variables to better understand the

[38] Implementing a probit model without an interaction effect of the two treatments yields coefficients in the same order of magnitude (results not shown).

**Table 3: Regression results for financial knowledge - Baseline OLS**

This table reports the OLS estimates of the effect of the framing treatment, the advice-giving treatment and several control variables on financial literacy after the experiment. The dependent variable is a dummy that equals 1 if the respective financial literacy question is answered correctly, 0 otherwise. Robust standard errors are shown in parentheses. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

| VARIABLES | FL4: Stock market | | FL5: Volatility of returns | | FL6: Comprehending risk | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Framing treatment: Finance frame | 0.0191 | -0.00572 | 0.126*** | 0.111*** | -0.0712* | -0.0743* |
| | (0.0422) | (0.0374) | (0.0408) | (0.0378) | (0.0427) | (0.0420) |
| Advice treatment: Giving advice | -0.0491 | -0.0629* | -0.0200 | -0.0367 | -0.0894** | -0.0680 |
| | (0.0422) | (0.0368) | (0.0408) | (0.0379) | (0.0427) | (0.0423) |
| Female | | -0.0674* | | -0.000800 | | -0.0269 |
| | | (0.0385) | | (0.0399) | | (0.0430) |
| Age (in years) | | 0.00490** | | 0.00252 | | 0.00165 |
| | | (0.00194) | | (0.00199) | | (0.00208) |
| Risk tolerance (0-10) | | -0.0249*** | | -0.0162* | | -0.00675 |
| | | (0.00804) | | (0.00869) | | (0.00918) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | | | |
| 2,000 to less than 3,500 Euro | | 0.0192 | | 0.000831 | | -0.0788 |
| | | (0.0576) | | (0.0586) | | (0.0613) |
| 3,500 to less than 5,000 Euro | | 0.0568 | | 0.0572 | | 0.0550 |
| | | (0.0627) | | (0.0601) | | (0.0660) |
| 5,000 Euro and more | | 0.0386 | | 0.0430 | | 0.134* |
| | | (0.0635) | | (0.0642) | | (0.0686) |
| Not specified | | -0.139* | | -0.130* | | -0.0371 |
| | | (0.0748) | | (0.0770) | | (0.0861) |
| *Reference category: Low education level* | | | | | | |
| Medium education level | | 0.0859 | | 0.149** | | 0.135** |
| | | (0.0573) | | (0.0619) | | (0.0630) |
| High education level | | 0.184*** | | 0.159** | | 0.226*** |
| | | (0.0599) | | (0.0630) | | (0.0635) |
| Conf. to make good fin. decisions bef. exp. (0-10) | | 0.0288*** | | 0.0117 | | 0.0177* |
| | | (0.0100) | | (0.00998) | | (0.0104) |
| "Big Three" correct | | 0.337*** | | 0.263*** | | 0.0705 |
| | | (0.0430) | | (0.0425) | | (0.0454) |
| East dummy | | 0.0337 | | -0.0897** | | 0.0432 |
| | | (0.0465) | | (0.0451) | | (0.0498) |
| Constant | 0.611*** | 0.116 | 0.593*** | 0.281** | 0.558*** | 0.199 |
| | (0.0358) | (0.121) | (0.0356) | (0.128) | (0.0365) | (0.126) |
| Observations | 544 | 543 | 544 | 543 | 544 | 543 |
| R-squared | 0.003 | 0.258 | 0.018 | 0.179 | 0.014 | 0.097 |

underlying context. FL6 is neither strongly correlated with the basic financial literacy questions on interest rate, inflation, and risk diversification, nor with the other two advanced financial literacy questions. Moreover, FL6 is not correlated with the "Big Three" dummy, stock ownership, household income, and confidence before using the tool. The strongest correlation is with the level of education (correlation coefficient of 0.21). Hence, this could indicate that FL6 does not accurately measure financial literacy, but rather basic numeracy, as the question required respondents to calculate the expected value.

The evaluation of the comprehension questions in Section 4.1 reveals that survey participants either seem to understand the tool and answer all three comprehension questions correctly or not (see Figure 4). Hence, a subgroup analysis based on tool understanding is necessary to ensure that compliers drive the results and that the framing treatment actually drives learning.

Table 4 shows the results for Equation (1) differentiating between three subgroups. First, participants who got all three questions wrong: They are so-called never-takers who were not treated successfully (Columns 1, 4, and 7). Second, the next subgroup comprises of participants who answered one to three questions correctly (Columns 2, 5, and 8). Third, the last subgroup shows the results for compliers who were successfully treated (Columns 3, 6, and 9). In this stricter definition, the participants understand the tool completely and answered all three comprehension questions correctly. The learning effect in FL5 only persists for those who are able to answer one or more comprehension questions correctly (Columns 5 and 6). This shows how crucial it is to understand the simulation tool. The finding once again emphasizes the need to make such a tool as easily accessible as possible. To improve tool understanding and foster learning, the instructions and explanations have to be easy to follow and take into account different levels of prior knowledge.

To ensure that the learning effect is indeed purely driven by FL5 on return volatility, I include two additional dummies for financial knowledge namely "at least one of FL4 and FL6 correct" and "both FL4 and FL6 correct" as robustness checks. The results are shown in Table A4, Columns 1 to 4 and confirm that indeed FL4 and FL6 do not drive the results. Furthermore, the learning effect captured in FL5 is not strong enough to increase the overall financial literacy score after the experiment (Columns 5 and 6) approximating for overall learning effects due to the usage of the simulation tool. However, being assigned to the advice-giving treatment has a significant negative effect on the overall financial literacy score after the experiment. This contradicts Hypothesis 2, which assumes that purely giving advice has no influence on financial knowledge. Concerning the inclusion of control variables, the patterns in Columns 2, 4, and 6 are similar to those found in Table 3. Finally, Columns 7 to 9 show the results for self-assessed financial literacy (*Self-assessed FL (0-6)*) – a subjective measure of financial knowledge. Again insignificant treatment effects can be detected. Interestingly, the female dummy is now statistically significant at the 1% level. This indicates that women are less sure concerning their

**Table 4: Regression results for financial knowledge by tool comprehension– OLS**

This table reports the OLS estimates of the effect of the framing treatment, the advice-giving treatment and several control variables on financial literacy after the experiment. The dependent variable is a dummy that equals 1 if the respective financial literacy question is answered correctly, 0 otherwise. Three subgroups are distinguished: those who answer (i) none (Columns 1, 4, and 7), (ii) one to three (Columns 2, 4, and 6), and (iii) all three (Columns 3, 6, and 9) comprehension questions correctly. Robust standard errors are shown in parentheses. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | FL4: Stock market | | | FL5: Volatility of returns | | | FL6: Comprehending risk | | |
| | All compreh. questions wrong | 1-3 compreh. questions correct | 3 compreh. questions correct | All compreh. questions wrong | 1-3 compreh. questions correct | 3 compreh. questions correct | All compreh. questions wrong | 1-3 compreh. questions correct | 3 compreh. questions correct |
| Framing treatment: Finance frame | -0.0228 | -0.00428 | -0.000120 | 0.115 | 0.125*** | 0.0837* | 0.0276 | -0.121** | -0.127* |
| | (0.0685) | (0.0447) | (0.0536) | (0.0741) | (0.0417) | (0.0482) | (0.0758) | (0.0520) | (0.0666) |
| Advice treatment: Giving advice | -0.0989 | -0.0305 | 0.0249 | -0.0210 | -0.0490 | -0.0407 | -0.0677 | -0.0570 | -0.0822 |
| | (0.0693) | (0.0438) | (0.0508) | (0.0709) | (0.0420) | (0.0499) | (0.0739) | (0.0517) | (0.0664) |
| Female | -0.0881 | -0.0667 | -0.0607 | 0.136* | -0.0709 | -0.112** | 0.0332 | -0.0600 | -0.0376 |
| | (0.0727) | (0.0461) | (0.0519) | (0.0774) | (0.0432) | (0.0489) | (0.0746) | (0.0534) | (0.0671) |
| Age (in years) | 0.0101*** | 0.00562** | 0.00485* | 0.00368 | 0.00692*** | 0.00985*** | 0.00291 | 0.00295 | 0.00318 |
| | (0.00365) | (0.00236) | (0.00288) | (0.00412) | (0.00219) | (0.00284) | (0.00386) | (0.00268) | (0.00341) |
| Risk tolerance (0-10) | -0.0219 | -0.0223** | 0.000903 | -0.0126 | 0.00604 | 0.00903 | -0.00393 | -0.00143 | -0.00616 |
| | (0.0150) | (0.0101) | (0.0117) | (0.0165) | (0.00967) | (0.0111) | (0.0163) | (0.0121) | (0.0155) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | | | | | | |
| 2,000 to less than 3,500 Euro | -0.0728 | 0.0335 | 0.131 | -0.0258 | -0.0616 | -0.104 | -0.0991 | -0.114 | -0.0995 |
| | (0.100) | (0.0751) | (0.101) | (0.107) | (0.0684) | (0.0816) | (0.104) | (0.0807) | (0.108) |
| 3,500 to less than 5,000 Euro | 0.0885 | 0.0317 | 0.173* | -0.106 | 0.0733 | 0.0208 | -0.0286 | 0.0403 | 0.00293 |
| | (0.114) | (0.0803) | (0.101) | (0.117) | (0.0659) | (0.0793) | (0.116) | (0.0859) | (0.111) |
| 5,000 Euro and more | -0.0481 | 0.0394 | 0.108 | -0.0604 | -3.70e-05 | -0.0682 | 0.109 | 0.0944 | 0.0304 |
| | (0.130) | (0.0782) | (0.106) | (0.127) | (0.0687) | (0.0845) | (0.131) | (0.0860) | (0.117) |
| Not specified | -0.178* | -0.0822 | 0.0326 | -0.222** | -0.0628 | 0.0244 | -0.0277 | -0.0580 | -0.0737 |
| | (0.0992) | (0.112) | (0.139) | (0.0912) | (0.107) | (0.117) | (0.126) | (0.125) | (0.155) |

**Table 4 (continued)**

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | FL4: Stock market | | | FL5: Volatility of returns | | | FL6: Comprehending risk | | |
| | All compreh. questions wrong | 1-3 compreh. questions correct | 3 compreh. questions correct | All compreh. questions wrong | 1-3 compreh. questions correct | 3 compreh. questions correct | All compreh. questions wrong | 1-3 compreh. questions correct | 3 compreh. questions correct |
| *Reference category: Low education level* | | | | | | | | | |
| Medium education level | 0.103 | 0.0272 | 0.00479 | 0.149 | 0.0670 | 0.177 | 0.0481 | 0.178* | 0.230* |
| | (0.0860) | (0.0814) | (0.123) | (0.0912) | (0.0805) | (0.108) | (0.0903) | (0.0950) | (0.138) |
| High education level | 0.275*** | 0.0880 | 0.0230 | 0.0639 | 0.130* | 0.187* | 0.167* | 0.256*** | 0.229* |
| | (0.101) | (0.0814) | (0.117) | (0.105) | (0.0767) | (0.0967) | (0.0987) | (0.0904) | (0.125) |
| Conf. to make good fin. decisions bef. exp. (0-10) | 0.0467*** | 0.0155 | 0.00459 | 0.0164 | 0.0132 | 0.00984 | 0.0379** | 0.00664 | 0.00369 |
| | (0.0177) | (0.0123) | (0.0149) | (0.0179) | (0.0119) | (0.0142) | (0.0183) | (0.0129) | (0.0165) |
| "Big Three" correct | 0.249*** | 0.325*** | 0.257*** | 0.271*** | 0.114** | 0.158** | 0.101 | 0.00591 | -0.0174 |
| | (0.0912) | (0.0551) | (0.0713) | (0.0965) | (0.0475) | (0.0627) | (0.0916) | (0.0568) | (0.0757) |
| East dummy | -0.0245 | 0.0793 | 0.0570 | 0.00652 | -0.137** | -0.129* | 0.0805 | 0.0321 | 0.0433 |
| | (0.0763) | (0.0568) | (0.0680) | (0.0808) | (0.0548) | (0.0697) | (0.0847) | (0.0628) | (0.0807) |
| Constant | -0.246 | 0.262* | 0.269 | 0.0224 | 0.267* | 0.155 | -0.106 | 0.308* | 0.397* |
| | (0.216) | (0.151) | (0.193) | (0.239) | (0.147) | (0.178) | (0.212) | (0.161) | (0.210) |
| Observations | 185 | 358 | 242 | 185 | 358 | 242 | 185 | 358 | 242 |
| R-squared | 0.234 | 0.214 | 0.172 | 0.153 | 0.145 | 0.187 | 0.111 | 0.084 | 0.064 |

ability to give correct answers to the financial literacy questions. This holds true even when controlling for prior confidence levels (Columns 8 and 9), as well as the actual overall financial literacy score (Column 9). This finding is in line with Bucher-Koenen *et al.* (2025a).

Note that the interaction effect between the framing treatment and the advice-giving treatment (i.e., $\beta_3$) is not statistically significant. The results using Equation (2) are summarized in Table A5. The overall interaction effect (i.e., $\beta_1 + \beta_2 + \beta_3$) is statistically insignificant for FL4 and for FL5 when including controls. The overall interaction effect for FL6, however, is statistically significant. This indicates that participants seeing the simulation tool in the finance frame and giving financial advice (see Group 0 in Table 1), are even less likely to answer FL6 correctly compared to those in the neutral framing treatment without giving advice (see Group 3 in Table 1). One explanation could be that individuals in Group 3 are less willing to make a cognitive effort because they are already exerting themselves. Since the expected value must be calculated in question FL6, this becomes particularly apparent here.

*Potential mechanism for learning effect: Transfer of knowledge?*

In the finance frame, participants receive information relevant for answering FL5 on the volatility of returns correctly at two points in the experiment. First, when clicking through the introductory slides (see Figure 3, Step 2). Here, the participants receive the information that, on average, returns and the total value of the assets saved can fluctuate more in the risky assets than in the risk-free assets. Second, the interactive graph visualizes the volatility by showing different investment scenarios (see Figure 3, Steps 3-5).

To analyze whether learning comes from the slide show, the tool, or the combination of both, I can take advantage of a special circumstance. My sample of *smartphone users* (N=544) saw the correct representation of the experimental flow, i.e., the Steps 1 to 5 are all tailored to either the neutral frame or the finance frame. In a second sample of N=458 *desktop users*, however, there was a mismatch in the set-up of the framing treatment. Here, participants randomly allocated to the neutral frame wrongly saw the introductory slides from the finance frame. Analogously, participants randomly allocated to the finance frame wrongly saw the introductory slides from the neutral frame. Consequently, the framing treatment is no longer clear-cut with regard to the use of financial jargon. Table A6 shows that desktop users (mismatched introductory slides) and smartphone users (correct introductory slides) are overall comparable in terms of their characteristics.[39]

[39] Smartphone users are more likely female and younger compared to desktop users. Furthermore, the share of participants with low levels of education is higher among smartphone users (19.1% for smartphone users versus 14.4% for desktop users). Smartphone users are slight less confident in their ability to make good financial decision than desktop users. While this difference is statistically significant, it is economically negligible. Finally, smartphone users are less likely to own both stocks and bonds. While 40.1% of smartphone users own stocks, this applies to 50% of desktop users. Similarly, 16% of smartphone users own bonds, while the share among desktop users is higher (21.6%).

Using the mismatched sample, Figure A5, Panel A shows that participants receiving the wrong slide show to their tool do not learn with regard to FL5. Both the share of correct answers and the share of "do not know/ refuse to answer" responses is not affected by either treatment. Further, this setting enables me to get first descriptive evidence whether learning comes from the slide show, the tool, or the combination of both. Interestingly, Figure A5, Panel B shows that participants in the finance frame receiving the correct slides are more likely to answer FL5 correctly than those receiving the wrong slides. The difference is statistically significant on the 5% level. Just seeing the finance slides without further visualization due to the neutral frame seem not to be sufficient for learning. Thus, additional explanations for the tool using finance jargon seem to induce learning. Participants seem to be unable to transfer knowledge from one frame to the other even though the underlying concepts are identical. The share of "do not know/ refuse to answer" responses is not affected.

Overall, there is only specific learning in the finance frame if the respective financial literacy question is directly related to the investment simulation tool's content. Moreover, it is crucial that the participants are able to understand the tool to induce learning. There is no transfer of knowledge between the neutral setting and the finance setting even though the underlying concepts are the same.

### 5.3. Confidence

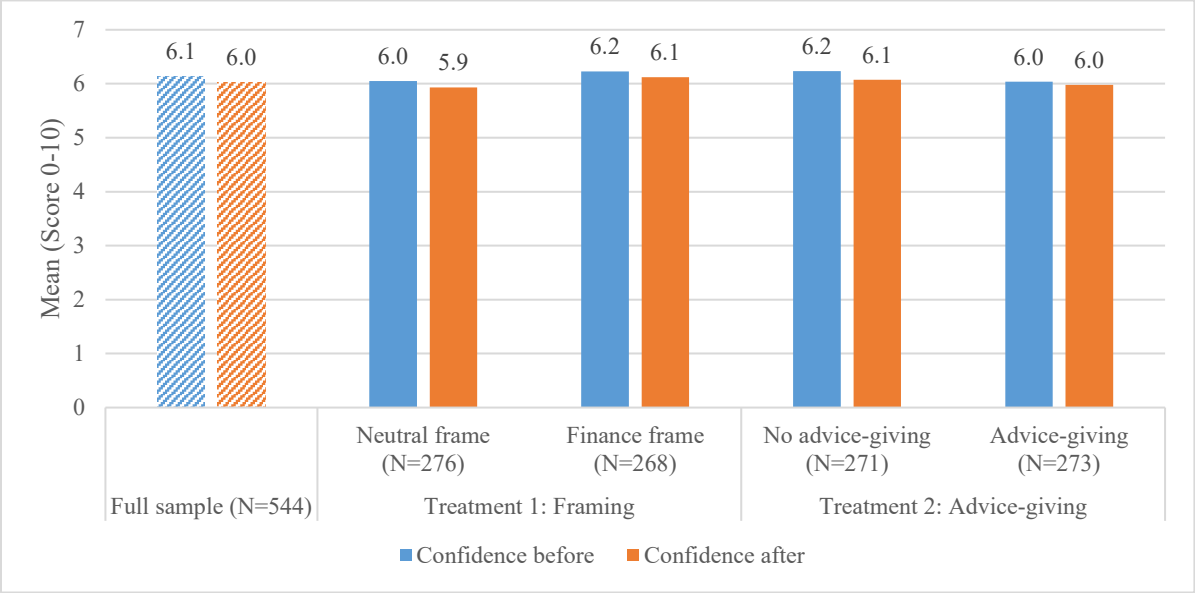
*Descriptive results*

The left panel of Figure 8 shows the mean confidence scores for the full sample both before and after the experiment. Before the experiment, participants indicated an average score of 6.1 (on a scale from 0 to 10). After the experiment, the respective value is 6.0.

In the middle panel and the right panel of Figure 8, the mean confidence scores for the framing treatment and the advice-giving treatment are displayed, respectively. There is very little variation in mean confidence scores and no clear pattern emerges.

Alternatively, confidence can be approximated by the share of "do not know/ refuse to answer" responses to the financial literacy questions (e.g., Bucher-Koenen *et al.*, 2025a). Figure 7, Panel B shows that the share of "do not know/ refuse to answer" responses for FL5 is higher in the neutral frame (21.4%) than in the finance frame (14.9%). The difference is statistically significant on the 5% level suggesting that participants in the finance frame are more confident in their ability to answer this question correctly. The advice-giving treatment, however, does not influence the response patterns for the share of "do not know/ refuse to answer" responses. Participants are not more confident in their ability to answer the question correctly.

**Figure 8: Confidence in ability to make good financial decisions before and after the experiment**




Notes: Figure 8 compares mean confidence scores before and after the experiment and differentiates between framing treatment and advice-giving treatment. The original question reads: *"How much confidence do you have in your ability to make good financial decisions?"* (Scale: 0 meaning "no confidence" to 10 meaning "very high confidence"). N=544.

Next, the change in confidence and further definitions of confidence are discussed. Figure A6, Panel A shows that, in the full sample, 38.2% of the respondents do not adjust their confidence level during the survey. 15.6% decrease their confidence rating by one point and 17.5% increase it by one point. Higher adjustments are seldom. This holds true for all four treatment groups. The distributions do not statistically differ from one another ($\chi^2 - test$: Pearson chi2(45) = 35.8712, Pr = 0.833).[40] Figure A6, Panel B summarizes the descriptive results of the indirect measures of confidence using the three statements. Again, the differences in means by framing treatment and by advice-giving treatment are not statistically significant for all three statements (t-tests not shown).

These results provide first descriptive evidence that there is no confidence boost due to the experiment. The two treatments do not seem to be able to shift confidence in one's own financial decision-making skills. The only exception is the significantly lower share "do not know/ refuse to answer" responses for FL5 in the finance frame compared to the neutral frame. Hence, overall, the results are not in favor of Hypothesis 3 and Hypothesis 4.

[40] The distributions of *difference in confidence* by framing treatment and by advice-giving treatment are also not significantly different from one another, respectively ($\chi^2$-tests not shown).

**Table 5: Regression results for confidence – Baseline OLS**

This table reports the OLS estimates of the effect of the framing treatment, the advice-giving treatment and several control variables on confidence. The dependent variables are confidence after the experiment (Columns 1 and 2) and a dummy measuring the number of "do not know" responses to the financial literacy questions after the experiment (Columns 3 and 4). Robust standard errors are shown in parentheses. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

| VARIABLES | (1) Confidence after the experiment (0-10) | (2) Confidence after the experiment (0-10) | (3) # DNK after (0-3) | (4) # DNK after (0-3) |
|---|---|---|---|---|
| Framing treatment: Finance frame | 0.195 | 0.0307 | -0.0316 | -0.0282 |
| | (0.207) | (0.152) | (0.0678) | (0.0619) |
| Advice treatment: Giving advice | -0.102 | 0.0822 | 0.112* | 0.101 |
| | (0.207) | (0.153) | (0.0678) | (0.0617) |
| Female | | -0.412** | | 0.0883 |
| | | (0.161) | | (0.0636) |
| Age (in years) | | -0.0111 | | -0.000142 |
| | | (0.00764) | | (0.00338) |
| Risk tolerance (0-10) | | 0.0452 | | -0.00530 |
| | | (0.0335) | | (0.0122) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | |
| 2,000 to less than 3,500 Euro | | 0.271 | | 0.274*** |
| | | (0.242) | | (0.103) |
| 3,500 to less than 5,000 Euro | | 0.552** | | 0.127 |
| | | (0.252) | | (0.102) |
| 5,000 Euro and more | | 0.225 | | 0.156 |
| | | (0.264) | | (0.105) |
| Not specified | | 0.0863 | | 0.712*** |
| | | (0.291) | | (0.167) |
| *Reference category: Low education level* | | | | |
| Medium education level | | 0.717*** | | -0.148 |
| | | (0.268) | | (0.109) |
| High education level | | 0.643** | | -0.269*** |
| | | (0.264) | | (0.102) |
| Conf. to make good fin. decisions bef. exp. (0-10) | | 0.749*** | | -0.0687*** |
| | | (0.0455) | | (0.0171) |
| "Big Three" correct | | 0.295* | | -0.395*** |
| | | (0.173) | | (0.0677) |
| East dummy | | -0.0552 | | 0.0203 |
| | | (0.188) | | (0.0739) |
| Constant | 6.981*** | 1.090** | 0.388*** | 1.062*** |
| | (0.185) | (0.486) | (0.0561) | (0.206) |
| Observations | 544 | 543 | 544 | 543 |
| R-squared | 0.002 | 0.489 | 0.005 | 0.200 |

*Regression results*

Table 5 presents the regression results for the main specification (Equation 1) of confidence using the *confidence after the experiment (0-10)* and the number of "do not know" responses among the three advanced financial literacy questions (*# DNK after (0-3)*) as dependent variables, respectively. It becomes evident that neither the framing treatment nor advice giving task is able to shift participants' confidence in their ability to make good financial decisions significantly.[41] Nevertheless, other factors seem to be important drivers of confidence. Women are less confident in their financial decision-making skills than men. Furthermore, higher levels of education, higher prior confidence, and better initial financial knowledge are positively correlated with confidence (Column 2). Analogously for the number of "do not know" responses, participants with higher education, higher prior confidence, and higher initial financial knowledge are less likely to give "do not know" responses (Column 4).

Table 6 contains several subgroup analyses using *confidence after the experiment (0-10)* as the dependent variable. This is necessary to ensure that compliers drive the results and that the advice-giving treatment actually drives changes in confidence. First, participants with a confidence score of 10 before the experiment are excluded because they cannot further improve their confidence score. This affects only N=20 participants which corresponds to 3.7% of the sample. The results are unaffected (Column 1). Second, splitting the sample along the median of confidence before the experiment might reveal interesting patterns.[42] Improvements might just occur for those with initial below-median confidence. The results, however, do not change (Columns 2 and 3). The aim of the advice-giving task was to boost confidence. However, one quarter of the respondents in the treatment group indicated that they could not give adequate financial advice and 10% of the participants provided invalid answers. Hence, third, I re-estimated Equation (1) excluding these two answer categories (Column 4). Now, I find a positive and significant effect of the advice-giving treatment on confidence after the tool for compliers to the advice-giving treatment. Fourth, I implement the median split by confidence before the tool for this restricted sample once more (Columns 5 and 6). The previous positive confidence boost due to the advice-giving treatment becomes stronger for participants with below-median confidence before the experiment. In contrast, the effect for those with above-median confidence before using the tool is not statistically significant. Finally, never takers and compliers to the framing treatment are analyzed (Columns 7 to 9). There is no change in confidence due to the framing treatment, no matter how many comprehension questions the participants are able to answer correctly.

[41] Analogously to the results for financial knowledge, estimating Equation (1) using a probit model yields coefficients in the same order of magnitude (results not shown).
[42] The median of confidence before using the tool is 6.

**Table 6: Regression results for confidence – subgroup analyses**

This table reports the OLS estimates of the effect of the framing treatment, the advice-giving treatment and several control variables on confidence. The dependent variable is confidence after the experiment (0-10). Several subgroups are considered. In Column 1, participants with a confidence score of 10 before the experiment are excluded. In Columns 2-3, the sample is split by median confidence before the experiment. In Columns 4-6, participants who are unable or not willing to give advice are excluded. In Columns 5 and 6, this subsample is split by median confidence before the experiment. In Columns 7-9, those who answer (i) none (Column 7), (ii) one to three (Column 8), and (iii) all three (Column 9) comprehension questions correctly are analyzed separately. Robust standard errors are shown in parentheses. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Excluding "invalid advice" and "unable to give advice" | | | | | |
| VARIABLES | Exclude score 10 | Below median (≤6) confidence before | Above median (>6) confidence before | Full sample | Below median (≤6) confidence before | Above median (>6) confidence before | All compreh. questions wrong | 1-3 compreh. questions correct | 3 compreh. questions correct |
| Framing treatment: Finance frame | -0.0515 | 0.144 | -0.0833 | 0.160 | 0.338 | 0.0127 | -0.108 | 0.101 | 0.0983 |
| | (0.149) | (0.223) | (0.204) | (0.155) | (0.226) | (0.215) | (0.327) | (0.166) | (0.173) |
| Advice treatment: Giving advice | 0.115 | 0.254 | -0.140 | 0.306* | 0.775*** | -0.228 | 0.0982 | 0.0767 | 0.176 |
| | (0.153) | (0.223) | (0.218) | (0.164) | (0.238) | (0.245) | (0.319) | (0.167) | (0.176) |
| Female | -0.332** | -0.345 | -0.463** | -0.398** | -0.177 | -0.521** | -0.852** | -0.282 | -0.345* |
| | (0.158) | (0.243) | (0.220) | (0.170) | (0.261) | (0.234) | (0.335) | (0.177) | (0.184) |
| Age (in years) | -0.0145* | -0.0114 | -0.0178* | -0.00960 | -0.00311 | -0.0216* | -0.0196 | 0.00538 | 0.00996 |
| | (0.00747) | (0.0108) | (0.0104) | (0.00791) | (0.0112) | (0.0114) | (0.0172) | (0.00834) | (0.00929) |
| Risk tolerance (0-10) | 0.0389 | 0.0936* | -0.00169 | 0.0180 | 0.0513 | -0.0349 | 0.0837 | 0.0586 | 0.0886** |
| | (0.0344) | (0.0546) | (0.0406) | (0.0344) | (0.0542) | (0.0438) | (0.0775) | (0.0357) | (0.0383) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | | | | | | |
| 2,000 to less than 3,500 Euro | 0.400* | 0.188 | 0.642* | 0.247 | 0.0182 | 0.779** | 0.124 | 0.259 | 0.138 |
| | (0.235) | (0.327) | (0.328) | (0.262) | (0.355) | (0.370) | (0.482) | (0.258) | (0.282) |
| 3,500 to less than 5,000 Euro | 0.658*** | 0.578 | 0.678** | 0.512** | 0.429 | 0.812** | 0.932* | 0.369 | 0.276 |
| | (0.248) | (0.365) | (0.343) | (0.256) | (0.367) | (0.368) | (0.525) | (0.253) | (0.296) |

**Table 6 (continued)**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Excluding "invalid advice" and "unable to give advice" | | | | | |
| VARIABLES | Exclude score 10 | Below median (≤6) confidence before | Above median (>6) confidence before | Full sample | Below median (≤6) confidence before | Above median (>6) confidence before | All compreh. questions wrong | 1-3 compreh. questions correct | 3 compreh. questions correct |
| 5,000 Euro and more | 0.310 | 0.179 | 0.459 | 0.198 | 0.132 | 0.471 | 0.573 | 0.0250 | 0.0296 |
| | (0.260) | (0.375) | (0.366) | (0.270) | (0.354) | (0.407) | (0.534) | (0.282) | (0.309) |
| Not specified | 0.288 | 0.0659 | 0.436 | -0.0985 | -0.302 | 0.483 | 0.0153 | 0.311 | 0.241 |
| | (0.283) | (0.395) | (0.364) | (0.289) | (0.403) | (0.357) | (0.533) | (0.292) | (0.369) |
| *Reference category: Low education level* | | | | | | | | | |
| Medium education level | 0.713*** | 0.756** | 0.421 | 0.869*** | 0.977*** | 0.470 | 0.650 | 0.517 | 0.0725 |
| | (0.261) | (0.355) | (0.395) | (0.285) | (0.362) | (0.446) | (0.457) | (0.332) | (0.346) |
| High education level | 0.674** | 0.512 | 0.507 | 0.709** | 0.753* | 0.422 | 0.592 | 0.435 | -0.109 |
| | (0.269) | (0.376) | (0.372) | (0.284) | (0.399) | (0.405) | (0.500) | (0.304) | (0.312) |
| Conf. to make good fin. decisions bef. exp. (0-10) | 0.684*** | 0.580*** | 0.857*** | 0.747*** | 0.711*** | 0.926*** | 0.638*** | 0.795*** | 0.784*** |
| | (0.0473) | (0.0984) | (0.114) | (0.0501) | (0.117) | (0.130) | (0.107) | (0.0439) | (0.0473) |
| "Big Three" correct | 0.263 | 0.522** | 0.141 | 0.0622 | 0.0199 | 0.158 | 0.347 | 0.0681 | 0.101 |
| | (0.173) | (0.258) | (0.227) | (0.184) | (0.281) | (0.246) | (0.430) | (0.200) | (0.210) |
| East dummy | -0.0497 | -0.342 | 0.291 | 0.0764 | -0.160 | 0.420 | -0.238 | 0.0336 | 0.168 |
| | (0.184) | (0.277) | (0.248) | (0.196) | (0.292) | (0.259) | (0.324) | (0.230) | (0.246) |
| Constant | 1.443*** | 1.573** | 0.910 | 1.185** | 0.709 | 0.571 | 1.963* | 0.528 | 0.996 |
| | (0.511) | (0.766) | (1.028) | (0.553) | (0.981) | (1.186) | (1.069) | (0.527) | (0.614) |
| Observations | 504 | 287 | 256 | 443 | 225 | 218 | 185 | 358 | 242 |
| R-squared | 0.450 | 0.276 | 0.239 | 0.508 | 0.366 | 0.255 | 0.452 | 0.535 | 0.619 |

Moreover, alternative measures of confidence are implemented to avoid measurement error. Table A7, Panel 1 shows the results for the three statements measuring confidence indirectly. Three (sub-)samples are displayed, respectively: i) full sample, ii) participants who give proper advice, and iii) participants who are able to answer all three comprehension questions correctly. Participants who see the simulation tool in the finance frame are more like to agree to the statement "*I have the confidence to participate in the stock market."* This holds true for both subgroups with a respective successful treatment (Columns 2 and 3). The female dummy is particularly strong (1% significance level) and large in magnitude. This reflects the overall hesitance of women to participant in the stock market (e.g., Bucher-Koenen *et al.*, 2023; 2025a). The experience in the simulation tool and the advice-giving task do not seem to be able to attenuate this phenomenon. Interestingly, participants living in the East are also less willing to participate in the stock market unless they understand the simulation tool. This finding is consistent with the results for a representative sample of the German population (e.g., Laudenbach *et al.*, 2020; Bucher-Koenen *et al.*, 2023).

Table A7, Panel 2 shows the results for the difference in confidence, and the increase and decrease dummies. Here, the advice-giving treatment has a positive and statistically significant effect on the difference in confidence for those how were able to give financial advice.

Note that the interaction effect between the framing treatment and the advice-giving treatment are not statistically significant. The results using Equation (2) are summarized in Table A8.

While the multivariate regression results overall reject Hypotheses 3 and 4, there is no rejection for specific subgroups of compliers. First, I find a confidence boost for compliers to the advice-giving treatment with below-median confidence. Hence, this result is in favor of Hypothesis 3. Second, giving participants the opportunity to explore the simulation tool in the finance framing increases their confidence to participate in the stock market if they comply with the two treatments. This finding is in favor of Hypothesis 4.

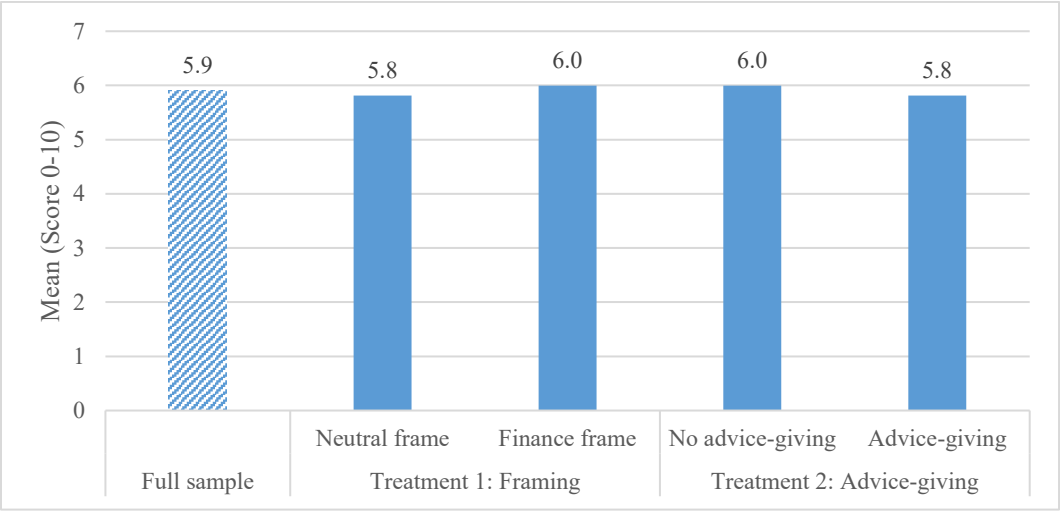
### 5.4. Motivation

*Descriptive results*

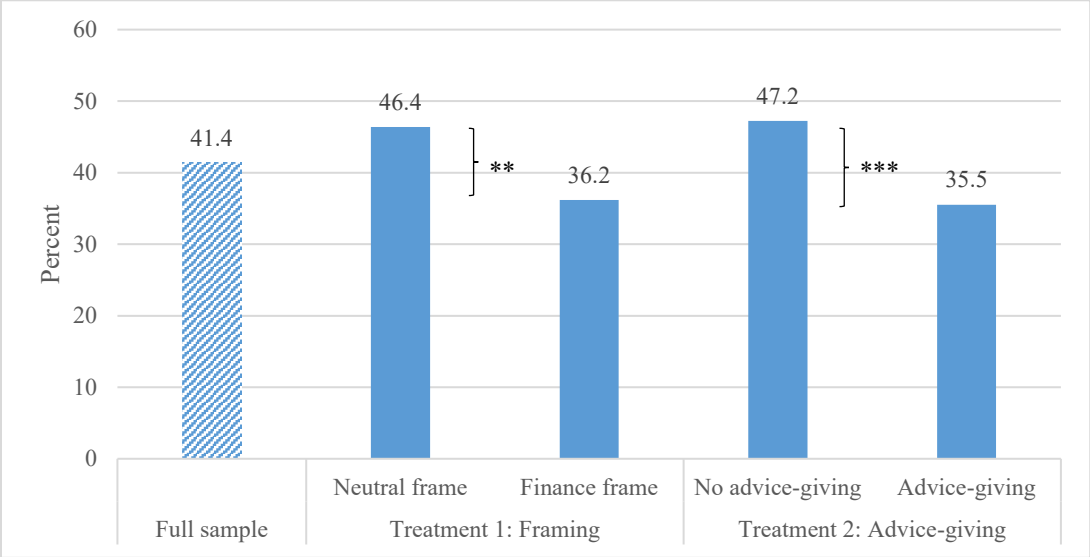
Figure 9, Panel A shows the descriptive results for the direct measure of motivation. Overall, participants in the survey are rather motivated to continue dealing with the topic of "saving and investing". Directly after the experiment, participants indicate, on average, a score of 5.9 (on a scale from 0 to 10). There is no significant change, neither due to the framing treatment nor due to the advice-giving task.

**Figure 9: Motivation**

**Panel A:** Motivation after the experiment (direct measure) by framing treatment and advice-giving treatment




**Panel B:** Motivation at the end of the experiment (indirect measure) by framing treatment and advice-giving treatment




Notes: Figure 9, Panel A shows the mean results for direct motivation by framing treatment and advice-giving treatment separately. The original question reads: *"How motivated are you to [further] deal with the topic of "saving and investing"?"* (Scale: 0 meaning "Not motivated at all" to 10 meaning "Very strongly motivated"). Panel B shows the results for indirect motivation by framing treatment and advice-giving treatment separately. The original question reads: *"Thank you for taking part in our survey! As a thank you, we offer you the opportunity to download one of these three resources free of charge." [E-book on investing; ZEW expert brief on COVID-crisis; Link to consumer advice center; No, thank you]*. Panel B shows the percentage of participants who downloaded one of the additional information sources at the end of the experiment (Dummy = 1 if one of the three documents was downloaded, 0 otherwise). N=544. T-tests are used to test differences between groups. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

In contrast to the direct motivation question, the indirect motivation measure at the very end of the survey requires follow-up effort, i.e., participants have to click on the download link to one of the documents and only afterwards have the opportunity to consult the additional material. Figure 9, Panel B shows that the majority of the respondents are not interested in the additional material. Only 41.4% downloaded one of the sources.[43] When differentiating the download behavior by the two treatments, a similar picture can be drawn both times. Participants in the neutral frame are more likely to download additional materials than those in the finance frame. In the advice-giving treatment, participants without the advice-giving task are more likely to download supplementary materials compared to those who gave advice. The differences in means are statistically significant. This hints towards a rejection of Hypotheses 5 and 6.

An explanation here could be that the experiment is very demanding, especially because the participants have to understand the simulation tool and, in addition, a subgroup was asked to give financial advice. Consequently, participants are tired at the end of the survey. When checking the time that participants took to complete the survey, I find that, on average, participant who are asked to give financial advice take longer to complete the survey than those in the control group not giving advice supporting the fatigue argument.[44]

*Regression results*

Table 7, Panel A shows the main regression results for motivation to further deal with the topic of "saving and investing" measured directly after the experiment (*direct motivation, 0-10*) using Equation (1).[45] Analogously to financial knowledge and confidence, the results are presented for three groups: i) the full sample (Columns 1 and 2), ii) those who give proper financial advice – so-called compliers to advice-giving treatment (Columns 3 and 4), and iii) those who understand the simulation tool – so-called compliers to the framing treatment (Columns 5 and 6). I find that – only in the subgroup of those who take the advice-giving task seriously and are able to give hypothetical financial advice – individuals in the advice-giving treatment group are more motivated compared to those in the control group, not giving advice (Column 3). Hence, there is only a boost in direct motivation for those with an effective advice-giving treatment. Confidence before the experiment and prior financial literacy are important drivers of

[43] Overall, 58.6% of the participants did not download any of the sources. Among the three download options, the E-book was the most popular choice (28.7%). The second option (ZEW expert brief) was only downloaded by 3.3%, while the link to the consumer advice center was chosen by 9.4% of the participants. Since the order of the download options was not randomized, there could be ordering effects at play.

[44] On average, participants in the treatment group (giving advice) took 16.2 minutes to complete the survey while those in the control group (not giving advice) took 15.4 minutes. This only takes participants into account who take less than 40 minutes to fill out the questionnaire (N=506). Figure A7 shows the distribution of the time it takes participants to complete the survey by advice-giving treatment. A Pearson's $\chi^2$-test reveals, however, that the two distributions are not statistically significantly different from one another. The same holds true for the framing treatment (results not shown).

[45] Implementing a probit model using Equation (1) yields coefficients in the same order of magnitude (results not shown).

**Table 7: Regression results for motivation – Baseline OLS**

This table reports the OLS estimates of the effect of the framing treatment, the advice-giving treatment and several control variables on motivation. In Panel A, the dependent variable is direct motivation (0-10). In Panel B, the dependent variable is indirect motivation, measured as a dummy that equals 1 if the participant downloaded a document, 0 otherwise. In Columns 1 and 2, the full sample is analyzed. In Columns 3 and 4, the sample is restricted to participants "giving proper advice", i.e., excluding the two answer categories "invalid advice" and "unable to give advice". In Columns 5 and 6, the sample is restricted to those who answer all three comprehension questions correctly. Robust standard errors are shown in parentheses. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

**Panel A: Motivation (direct, 0-10)**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| VARIABLES | Full sample | | Giving proper advice | | 3 compreh. questions correct | |
| Framing treatment: Finance frame | 0.128 | 0.105 | 0.144 | 0.0496 | 0.311 | 0.264 |
| | (0.217) | (0.199) | (0.233) | (0.213) | (0.310) | (0.302) |
| Advice treatment: Giving advice | 0.0470 | 0.0314 | 0.458* | 0.277 | 0.244 | 0.163 |
| | (0.220) | (0.199) | (0.238) | (0.215) | (0.297) | (0.276) |
| Female | -0.185 | 0.0709 | -0.212 | 0.0332 | -0.338 | -0.127 |
| | (0.225) | (0.202) | (0.242) | (0.218) | (0.296) | (0.285) |
| Age (in years) | -0.0443*** | -0.0396*** | -0.0392*** | -0.0341*** | -0.0519*** | -0.0595*** |
| | (0.0110) | (0.0105) | (0.0120) | (0.0114) | (0.0180) | (0.0178) |
| Risk tolerance (0-10) | 0.148*** | 0.131*** | 0.140** | 0.133*** | 0.0966 | 0.0487 |
| | (0.0523) | (0.0482) | (0.0561) | (0.0508) | (0.0725) | (0.0714) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | | | |
| 2,000 to less than 3,500 Euro | 0.395 | 0.250 | 0.00182 | -0.148 | 0.239 | 0.174 |
| | (0.342) | (0.314) | (0.376) | (0.333) | (0.546) | (0.538) |
| 3,500 to less than 5,000 Euro | 0.557* | 0.207 | 0.0885 | -0.236 | 0.400 | 0.227 |
| | (0.337) | (0.318) | (0.349) | (0.322) | (0.531) | (0.517) |
| 5,000 Euro and more | 0.813** | 0.643* | 0.329 | 0.195 | 0.996 | 0.971 |
| | (0.374) | (0.356) | (0.383) | (0.348) | (0.620) | (0.606) |
| Not specified | -0.273 | -0.264 | -0.437 | -0.370 | -0.0728 | -0.200 |
| | (0.394) | (0.401) | (0.424) | (0.433) | (0.501) | (0.519) |

**Table 7, Panel A (continued)**

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full sample | | Giving proper advice | | 3 compreh. questions correct | |
| *Reference category: Low education level* | | | | | | |
| Medium education level | 0.577 | 0.0939 | 0.722* | 0.175 | 0.253 | 0.162 |
| | (0.368) | (0.318) | (0.427) | (0.375) | (0.558) | (0.509) |
| High education level | 0.500 | 0.0211 | 0.674* | 0.209 | -0.369 | -0.366 |
| | (0.345) | (0.307) | (0.389) | (0.347) | (0.461) | (0.437) |
| East dummy | -0.0371 | -0.00282 | 0.0645 | 0.0199 | 0.661* | 0.574* |
| | (0.249) | (0.217) | (0.276) | (0.244) | (0.344) | (0.302) |
| Conf. to make good fin. decisions bef. exp. (0-10) | 0.483*** | 0.0401 | 0.488*** | 0.0328 | 0.465*** | 0.0440 |
| | (0.0644) | (0.0876) | (0.0702) | (0.0897) | (0.0819) | (0.103) |
| Conf. to make good fin. decisions after exp. (0-10) | | 0.576*** | | 0.604*** | | 0.535*** |
| | | (0.0746) | | (0.0809) | | (0.0972) |
| "Big Three" correct | 0.694*** | 0.396* | 0.695*** | 0.619** | 1.155*** | 1.050*** |
| | (0.233) | (0.235) | (0.254) | (0.244) | (0.343) | (0.348) |
| FL score (0-3, after) | | 0.190 | | 0.0644 | | 0.127 |
| | | (0.118) | | (0.129) | | (0.198) |
| Constant | 3.162*** | 2.420*** | 3.132*** | 2.385*** | 4.128*** | 3.491*** |
| | (0.674) | (0.597) | (0.762) | (0.675) | (0.930) | (0.848) |
| Observations | 543 | 543 | 443 | 443 | 242 | 242 |
| R-squared | 0.263 | 0.387 | 0.257 | 0.385 | 0.283 | 0.353 |

**Table 7, Panel B: Motivation (indirect, download 0/1)**

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full sample | | Giving proper advice | | 3 compreh. questions correct | |
| Framing treatment: Finance frame | -0.0957** | -0.0973** | -0.105** | -0.107** | -0.0974 | -0.0951 |
| | (0.0406) | (0.0404) | (0.0449) | (0.0448) | (0.0643) | (0.0648) |
| Advice treatment: Giving advice | -0.0840** | -0.0802** | -0.106** | -0.110** | -0.158** | -0.153** |
| | (0.0405) | (0.0408) | (0.0472) | (0.0471) | (0.0649) | (0.0654) |
| Female | 0.0224 | 0.0334 | 0.0133 | 0.0235 | 0.0356 | 0.0366 |
| | (0.0415) | (0.0418) | (0.0460) | (0.0466) | (0.0640) | (0.0654) |
| Age (in years) | -0.00433** | -0.00440** | -0.00402* | -0.00427* | -0.00197 | -0.00230 |
| | (0.00205) | (0.00205) | (0.00228) | (0.00228) | (0.00324) | (0.00334) |
| Risk tolerance (0-10) | 0.0228*** | 0.0235*** | 0.0157 | 0.0172* | 0.00426 | 0.00529 |
| | (0.00881) | (0.00886) | (0.00977) | (0.00988) | (0.0156) | (0.0156) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | | | |
| 2,000 to less than 3,500 Euro | -0.00790 | -0.0113 | 0.0196 | 0.0147 | 0.00538 | 0.00895 |
| | (0.0584) | (0.0584) | (0.0659) | (0.0660) | (0.107) | (0.107) |
| 3,500 to less than 5,000 Euro | 0.112* | 0.0964 | 0.192*** | 0.174** | 0.134 | 0.132 |
| | (0.0626) | (0.0631) | (0.0715) | (0.0721) | (0.109) | (0.109) |
| 5,000 Euro and more | 0.0704 | 0.0592 | 0.108 | 0.0961 | 0.137 | 0.136 |
| | (0.0672) | (0.0675) | (0.0739) | (0.0740) | (0.116) | (0.116) |
| Not specified | -0.164** | -0.156** | -0.158* | -0.152* | -0.165 | -0.161 |
| | (0.0724) | (0.0716) | (0.0826) | (0.0819) | (0.137) | (0.137) |
| *Reference category: Low education level* | | | | | | |
| Medium education level | 0.0795 | 0.0538 | 0.0730 | 0.0444 | 0.0811 | 0.0715 |
| | (0.0577) | (0.0582) | (0.0683) | (0.0691) | (0.134) | (0.133) |
| High education level | 0.208*** | 0.177*** | 0.210*** | 0.176** | 0.159 | 0.146 |
| | (0.0609) | (0.0624) | (0.0688) | (0.0710) | (0.118) | (0.119) |

**Table 7, Panel B (continued)**

| VARIABLES | (1) Full sample | (2) Full sample | (3) Giving proper advice | (4) Giving proper advice | (5) 3 compreh. questions correct | (6) 3 compreh. questions correct |
|---|---|---|---|---|---|---|
| East dummy | -0.0498 | -0.0483 | -0.0257 | -0.0263 | -0.0215 | -0.0186 |
| | (0.0464) | (0.0463) | (0.0536) | (0.0536) | (0.0774) | (0.0769) |
| Conf. to make good fin. decisions bef. exp. (0-10) | 0.00629 | -0.0101 | 0.00962 | -0.00683 | -0.00563 | 0.00385 |
| | (0.0100) | (0.0126) | (0.0112) | (0.0150) | (0.0160) | (0.0257) |
| Conf. to make good fin. decisions after exp. (0-10) | | 0.0194* | | 0.0190 | | -0.0127 |
| | | (0.0108) | | (0.0133) | | (0.0238) |
| "Big Three" correct | 0.0748* | 0.0477 | 0.0785 | 0.0561 | 0.130* | 0.121 |
| | (0.0438) | (0.0470) | (0.0488) | (0.0514) | (0.0749) | (0.0778) |
| FL score (0-3, after) | | 0.0320 | | 0.0355 | | 0.0254 |
| | | (0.0240) | | (0.0275) | | (0.0414) |
| Constant | 0.295** | 0.254** | 0.274** | 0.234* | 0.443** | 0.435** |
| | (0.122) | (0.125) | (0.134) | (0.137) | (0.194) | (0.201) |
| Observations | 543 | 543 | 443 | 443 | 242 | 242 |
| R-squared | 0.139 | 0.147 | 0.151 | 0.159 | 0.115 | 0.117 |

motivation (Columns 1, 3 and 5). Eskreis-Winkler *et al.* (2018) find that a boost in confidence translates into students' higher motivation. Thus, I include confidence after the experiment and financial literacy after the experiment (*FL score (0-3, after)*) as additional controls (Columns 2, 4, and 6). It becomes evident that confidence after the experiment drives results. The advice-giving treatment does no longer have a significant impact if confidence after is controlled for. Hence, I identify an important channel: higher confidence translates into higher motivation. Advanced financial literacy is not decisive. Furthermore, older respondents are less motivated to further deal with the topic of "saving and investing". One explanation might be that they already planned for their old age and, hence, do not see the necessity to take further action.

Table 7, Panel B shows the main regression results for indirect motivation using Equation (1).[46] It is structured analogously to Panel A. For the full sample and for those giving proper advice, I find that participants in both the finance frame treatment and the advice-giving treatment are significantly less motivated to download additional material at the very end of the questionnaire (Columns 1 to 4). An explanation might be that participants are tired at the end of the survey, especially those with the additional advice-giving task. Participants in the advice-giving treatment group need slightly longer to complete the questionnaire than those in the control group (see footnote 44). Interestingly, for those understanding the tool, seeing the tool in the finance frame does no longer significantly diminish their indirect motivation. Furthermore, in line with the findings for direct motivation, older participants are even less likely to download additional material. Participants with higher risk tolerance and better education levels are more likely to click on the download link. There seems to be a persistent threshold for (vulnerable) individuals to access readily available information. Interestingly, prior confidence and gender have no significant effect.[47] Hence, these findings reject Hypotheses 6. Concerning Hypothesis 5, successfully treated participants in the advice-giving treatment are more motivated to further deal with the topic of "saving and investing" which is in line with Hypothesis 5. However, this short-term boost in motivation does not translate into further actions at the end of the questionnaire – rejecting the second part of Hypothesis 5.

Table A9 shows the OLS regression results when using Equation (2) including the interaction effect between the two treatment dummies. For motivation measured directly after the experiment, the overall interaction effect (i.e., $\beta_1 + \beta_2 + \beta_3$) is not statistically significant (Columns 1 to 3). When looking at indirect motivation in Columns 4 to 6, however, the overall interaction effect is negative and stays statistically significant at the 1% level when including controls (e.g., for Column 5: –0.116 – 0.103 + 0.0393 = – 0.1797). This means that participants in the finance frame with the advice-giving task are approximately 18 p.p. less likely to download a document than those in the neutral frame without the

[46] Implementing a probit model using Equation (1) yields coefficients in the same order of magnitude (results not shown).

[47] Re-estimating Table 7, Panel B and excluding N=18 participants who chose the ZEW expert brief, does not change the results (results not shown). This represents a stricter measure as this document does not provide direct financial knowledge or further information with regard to finances.

advice-giving task. The findings for the control variables are consistent with the results from the baseline model. These results suggest that providing further information at the end of a questionnaire might not be the most efficient way to distribute additional learning material.

## 6. Conclusion

Online brokers and robo-advisors have become important market players in the financial sector. They facilitate investing in the capital market, which is one strategy to accumulate wealth, e.g., to ensure sufficient retirement income or to compensate for inflation. They use investment simulation tools to visualize portfolio choices and illustrate investment scenarios. Little is known about how these simulation tools influence user behavior and attitudes. In this paper, I implement and test a simplified investment simulation tool. My design is based on main features that commercial robo-advisors use in their investment simulation tools. To test for learning effects and track motivation, I frame the simulation tool in two ways: In the finance frame, the trade-off between risk and return on the capital market is illustrated. In the neutral frame, a trade-off independent of the finance context is introduced avoiding financial jargon. Furthermore, in the context of financial decision-making and wealth accumulation, confidence in one's financial decision-making skills plays an important role. I investigate the effect of an additional advice-giving task on confidence and motivation. The experiment is conducted using a 2x2 between-subjects design with a sample of smartphone users in Germany.

The most important results from the experiment can be summarized in four points. First, the majority of participants understands the simulation tool independent of the framing treatment. Nevertheless, one third of the participants struggles with the seemingly simple tool. Especially participants with lower financial knowledge have difficulties understanding its content. Second, participants improve their financial knowledge only in domains directly related to the tool's content. Understanding the tool is a crucial prerequisite for learning. There is no transfer on knowledge. Third, overall, neither the simulation tool nor the advice-giving task influence individuals' confidence in their ability to make good financial decisions. However, when looking at those who are able and willing to give financial advice and have below-median confidence before the experiment, I find a positive effect of the advice-giving treatment on individuals' confidence after the tool. Fourth, the advice-giving treatment increases motivation to deal with the topic of "saving and investing" directly after using the simulation tool for compliers to this treatment. This positive effect, however, does not last until the end of the questionnaire. Rather, the opposite is the case. Individuals in both the finance frame treatment group and the advice-giving treatment group are discouraged and refrain from taking further actions in the form of downloading additional materials at the end of the survey.

Currently, robo-advisors and online brokers rather address younger and tech-forward individuals. Their influence will continue to grow in the future (e.g., Tiberius *et al.*, 2022). Hence, widening the scope to a broader audience would give everyone the opportunity to benefit from such simulation tools. For this

to be successful, my results call for the careful design of such simulation tools. It is important that individuals are not overwhelmed and that adequate explanations are provided, taking into account the needs of people with less financial literacy.

Though I tried to be comprehensive, several aspects in my experimental setting can be developed further: generalizability, tailoring of the tool's content, and feedback on the advice-giving task. First, the sample is restricted to smartphone users in Germany aged 18 to 55 years. Conducting the survey with a larger representative sample of the German adult population will be even more inclusive and provide insights for a broader target group. A larger sample size also allows to analyze differences by vulnerable subgroups, such as women or less financially literate individuals. Second, the simulation tool has a very simple structure and cannot be varied in terms of complexity. While this is informative in the initial stage, it would be interesting to vary the complexity of the tool to find out which representation is most helpful for whom. Moreover, variation in word choice and explanations might yield additional insights. More detailed comprehension questions could provide insight into which features participants find particularly difficult and why. The participants in my experiment were paid a flat amount by the survey agency. To make the choices more realistic and to improve participants' engagement, monetary incentives could be included, e.g., by linking choice in the tool to actual payouts at the end of the survey. Third, to ensure comparability across groups, the advice-giving task was purely hypothetical. In a more complex setting, real interactions and matching in real time with other participants might increase the effectiveness of the treatment. The effect of direct feedback on the helpfulness of the given advice might be interesting to study.

Future research could focus on how participants interpret the interactive graph. Which elements are particularly challenging? Enriching survey data with qualitative data might yield additional insights. Moreover, special attention has to be given to additional explanatory elements supporting users, especially those with less prior knowledge about finance. Eye-Tracking methods might give new insights into how people approach such tools.

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**Appendix A: Technical details of the simulation tool**

In the interactive graph, I show the results of a simulation study which is based on Bucher-Koenen et al. (2019). In the simulation, I include two components: i) a risk-free asset and ii) a risky asset. In the following, I describe how both are calculated in the respective scenarios.

**i) The risk-free asset: savings account (German equivalent: Sparbuch)**

To calculate the future value of the annuity, the following formula is used (Tietze, 2015, p. 102f):

$$K_t = K * \frac{(q^t - 1)}{(q - 1)}, \text{ where } q = \left(1 + \frac{i}{100}\right) \quad (1)$$

A risk-free interest rate of $i_{risk-free} = 1\%$ per year is assumed. Take the example of a monthly payment of 100 Euro, i.e., $K = 1{,}200\ Euro$ per year. Hence, with an investment horizon of $t = 21$ years, this results in the following accumulated wealth $K_{t=21}$:

$$K_{t=21} = 1{,}200\ Euro * \frac{(1.01^{21} - 1)}{(1.01 - 1)} = 27{,}887.03\ Euro \quad (2)$$

Participants see the rounded value to the nearest hundred, i.e., in this case 27,900 Euro, if they choose 0% of the risky assets in the simulation tool.

In the risk-free case, the variance is assumed $\sigma^2 = 0$. Hence, the accumulated wealth does not vary over time and stays constant in all three scenarios.[48]

**ii) Risky asset: stocks**

The average outcome scenario for the risky asset is calculated using equation (1). In Euro, for the last 25 years, the MSCI World Index in Euro had an annualized return of $i_{risky} = 5.9\%$.

To simplify the presentation of risk, the participants are shown the 90 percent confidence interval. I simplify the presentation further by describing the confidence intervals in words, i.e., the outcome in the "best 5 out of 100" and in the "worst 5 out of 100" cases.

I use a standard deviation of total returns for the risky asset per year to be $s.d. = 0.146$. For the course of 20 years, the standard deviation is derived using a Monte Carlo simulation (N=1,000,000). Based on this simulation, I assume a combined standard deviation of $s.d. = 0.43$ over the course of 20 years.[49]

**iii) Mixed case**

In the mixed case of the risk-free and the risky assets, the standard deviation depends on the ratio between the two assets.

[48] The three scenarios are "best 5 out 100 cases", average scenario, "worst 5 out of 100 cases".
[49] The Python code of the underlying calculation can be made available upon request.

## Appendix B: The experiment

### Part 1: Wording of invitation e-mail sent by survey agency

| |
|---|
| "Dear Ms/Mr XY,<br>Today we would like to invite you to take part in our survey on the subject of "pension decisions".<br>It will take about 20 minutes to answer the questions.<br>To take part in the survey, simply click on the following link: XXX<br>As a thank you for your participation, xxx points will be credited to your points account.<br>We look forward to your support!" |

### Part 2: Introduction of the simulation tool

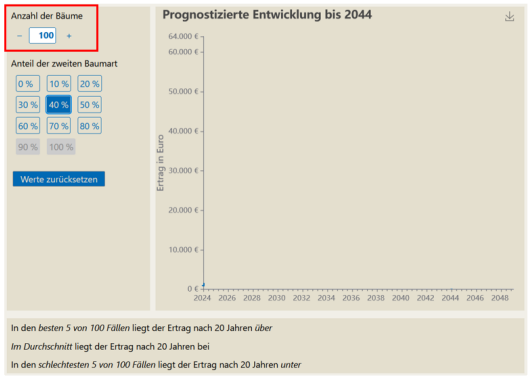
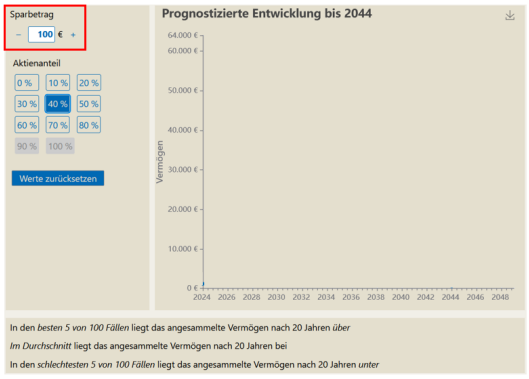
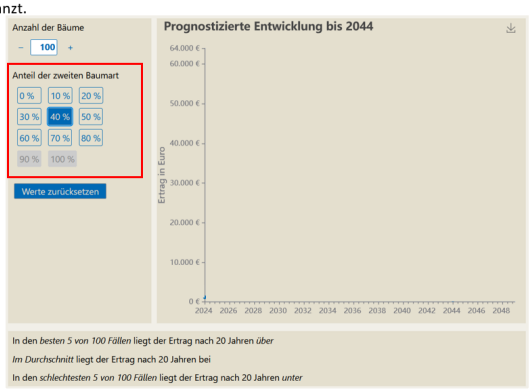
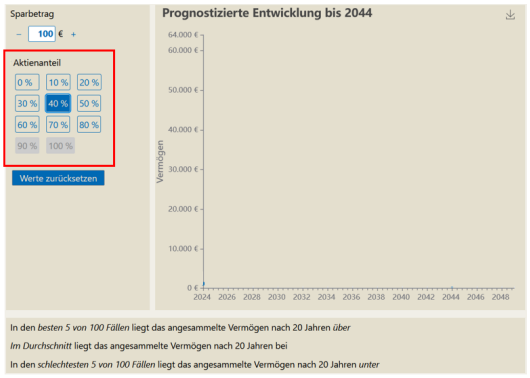
### Step 1: Introductory text

| **Neutral frame (Group 0 and Group 2)** |
|---|
| "The following is about **cultivation decisions in forestry**.<br>There are various ways of planting a section of forest. An example: A person owns a section of forest and has to decide which **tree species** to plant. They can choose **between two species**.<br>Tree species 1: This species grows *more slowly* and produces *lower* yields on average. At the same time, it is *more resistant* to pests. This means that yields *hardly fluctuate*.<br>Tree species 2: This species grows *faster* and achieves *higher* yields on average. At the same time, it is *more susceptible* to pests. This means that yields *fluctuate more*.<br>In an interactive graphic, we try to illustrate the **trade-off between yield and resilience** of both tree species. The price for both tree species is the same in our example." |
| **Finance frame (Group 1 and Group 3)** |
| "The following is about **investment decisions in the context of retirement provision**.<br>There are various ways to provide for old age. One option is to **save a monthly amount of money** over a **long time horizon**. In this example, a person can choose between two forms of investment.<br>Option 1: Saving with a savings account.<br>A savings account is a *low-risk* investment that generates *constant returns*. The assets saved do *not fluctuate*, but are *lower* on average as the returns are low.<br>Option 2: Saving with shares. Shares are securities with which shareholders acquire shares in companies.<br>Shares have a *higher risk* and generate *higher returns on average* over a longer period of time. At the same time, the returns and the total value of the assets saved can *fluctuate*.<br>In an interactive graphic, we try to illustrate the **trade-off between the risks and returns** of investing in the capital market." |

## Step 2: Slide show

The slide show shown here is used for PC, laptop or Tablet usage. There exists an adjusted version to make it compatible for smart phones.

***Original German version:***

| Neutral frame | Finance frame |
|---|---|
| Wir stellen Ihnen jetzt eine interaktive Graphik vor. | Wir stellen Ihnen jetzt eine interaktive Graphik vor. |
| Anzahl der Bäume: Diese Zahl zeigt an, wie viel **Bäume** jedes Jahr auf dem Waldstück gepflanzt werden.<br>  | Sparbetrag: Diese Zahl zeigt an, welcher **Geldbetrag monatlich** gespart wird.<br>  |
| Anteil der zweiten Baumart: Dieser Wert zeigt an, welchen **Anteil die zweite Baumart** (schnell wachsend, weniger widerstandsfähig) an der Gesamtfläche des Waldstücks haben soll. Der Rest des Waldstücks wird mit Baumart 1 (langsam wachsend, widerstandsfähiger) bepflanzt.<br>  | Aktienanteil: Dieser Wert zeigt an, wie das Geld angelegt wird. Es gibt die Wahl zwischen einem sicheren Sparbuch und einer Investition in Aktien.<br>Wählen Sie den **Anteil** aus, der in **Aktien investiert** wird. Der Restbetrag wird in ein **Sparbuch** investiert.<br>  |

Zur Erinnerung:

**Baumart 1:** Diese Art wächst **langsamer** und erzielt im Durchschnitt **geringere Erträge**. Gleichzeitig ist sie **widerstandsfähiger** gegen Schädlinge.

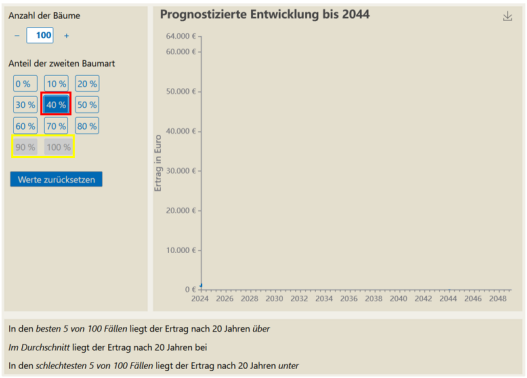
Mehr Widerstandsfähigkeit bedeutet, dass die Erträge **kaum schwanken**.

**Baumart 2:** Diese Art wächst **schneller** und erzielt im Durchschnitt **höhere Erträge**. Gleichzeitig ist sie **anfälliger** für Schädlinge.

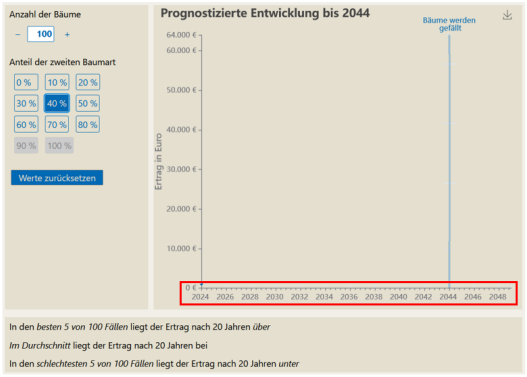
Weniger Widerstandsfähigkeit bedeutet, dass die Erträge **stärker schwanken**.

Beispiel: Das rot markierte Feld bedeutet, dass auf 40% der Fläche Baumart 2 gepflanzt wird und auf den restlichen 60% Baumart 1.

Hinweis: Die gelb markierten Felder mit einem Anteil von Baumart 2 von über 90% sind grau hinterlegt, da diese Anteile in der Praxis kaum vorkommen.




Zeithorizont: Der Zeithorizont beschreibt, wie lange das Baumpflanzprojekt dauert.
In allen drei Fällen ist der Zeithorizont 20 Jahre.




Zur Erinnerung:

**Möglichkeit 1:** Sparen mit **Sparbuch.**

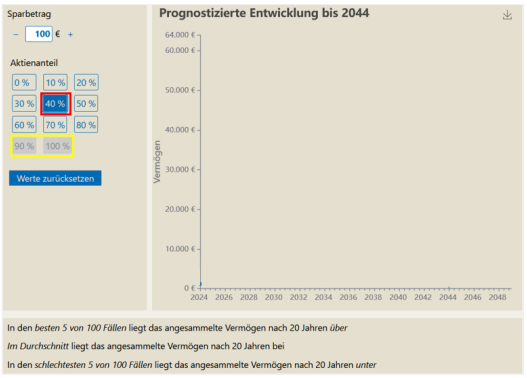
Ein Sparbuch ist eine Anlage **mit geringem Risiko** und erzielt **konstante Erträge.** Das **angesparte Vermögen schwankt nicht,** ist im Durchschnitt jedoch **geringer**, da die Erträge gering sind.

**Möglichkeit 2:** Sparen mit **Aktien.** Aktien sind Wertpapiere, mit denen Aktionäre Anteile an Unternehmen erwerben.

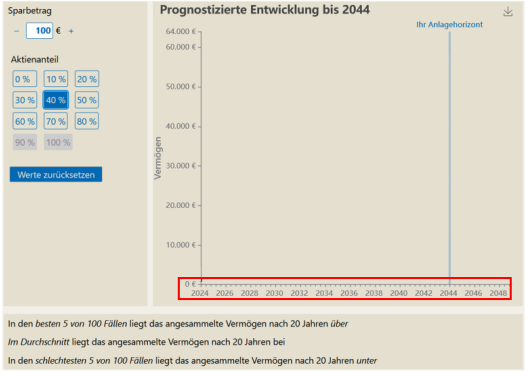
Aktien haben ein **höheres Risiko** und erzielen **im Durchschnitt** über einen längeren Zeitraum **höhere Erträge.** Gleichzeitig können die Renditen und der Gesamtwert des angesparten Vermögens **schwanken**.

Beispiel: Das rot markierte Feld bedeutet, dass 40% des monatlichen Sparbetrags in Aktien investiert werden und 60% in ein Sparbuch.

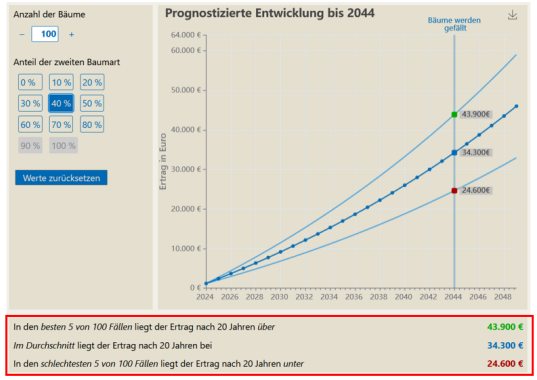
Hinweis: Die gelb markierten Felder mit einem Aktienanteil von über 90% sind grau hinterlegt, da sie in der Praxis selten angeboten werden.




Anlagehorizont: Der Anlagehorizont beschreibt, wie lange das Geld angespart wird.
In allen drei Fällen ist der Anlagehorizont 20 Jahre.

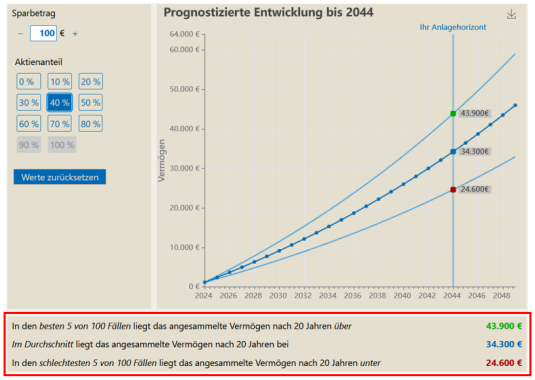


Ertragsentwicklung bis 2044: Die drei Fälle zeigen mögliche Ertragsentwicklungen über 20 Jahre.



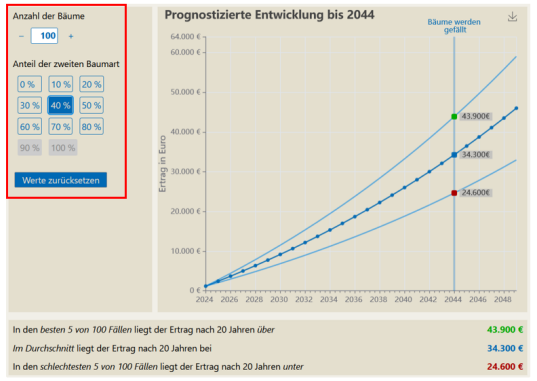

Wertentwicklung bis 2044: Die drei Fälle zeigen mögliche Wertentwicklungen über 20 Jahre.

Die Aktienrendite basiert auf Hochrechnungen der durchschnittlichen weltweiten Wertentwicklung der Kapitalmärkte der letzten 25 Jahre.
Wir nehmen an, dass das Sparbuch eine jährliche Rendite von 1% hat.



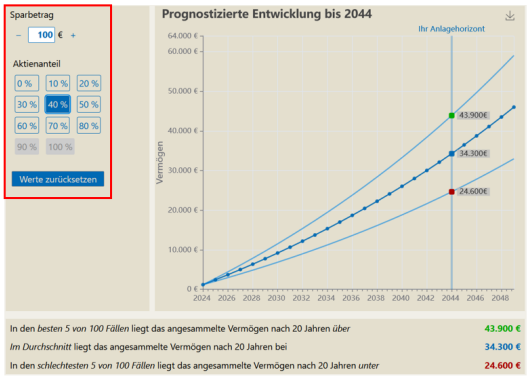

Zusammenfassung: Die Anzahl der Bäume, die jährlich gepflanzt werden, und der Anteil der zweiten Baumart können von Ihnen angepasst werden.

*Probieren Sie die interaktive Graphik nun selbst aus.*




Zusammenfassung: Der monatliche Sparbetrag und der Aktienanteil können von Ihnen angepasst werden.

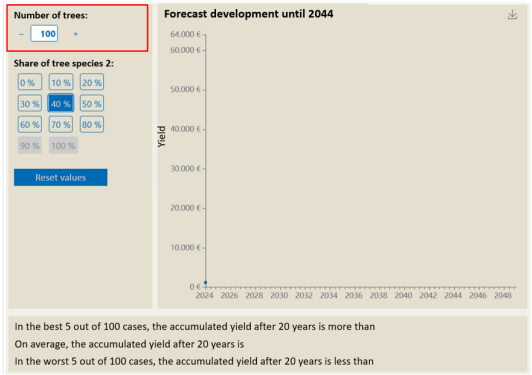
*Probieren Sie die interaktive Graphik nun selbst aus.*



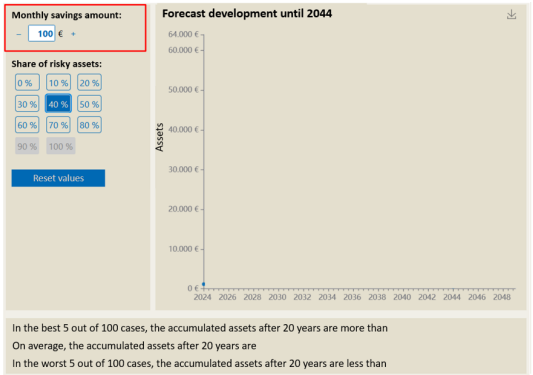

## *English version:*

| Neutral frame (Group 0 and Group 2) | Finance frame (Group 1 and Group 3) |
|---|---|
| We now present you with an interactive graph. | We now present you with an interactive graph. |

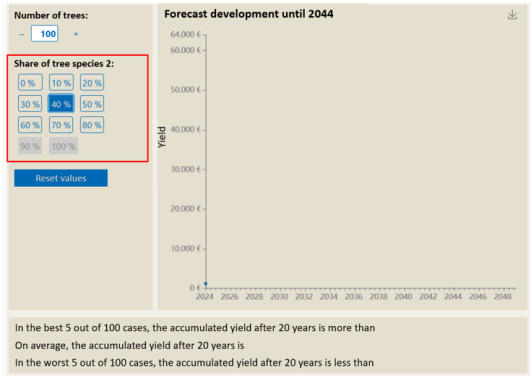
Number of trees: This number shows how many **trees** are planted on the forest plot each year.




Savings amount: This number shows the amount of **money saved each month**.

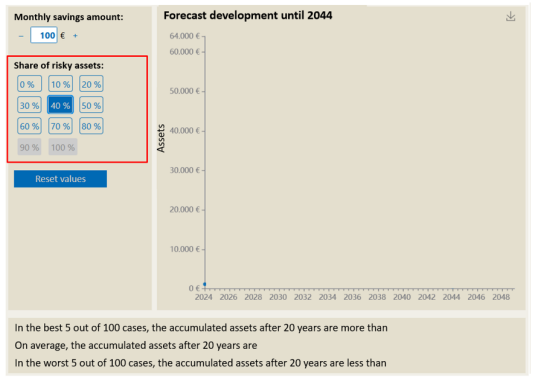



Share of tree species 2: This value shows the proportion of the **second tree species** (fast-growing, less resistant) in the total area of the forest plot. The rest of the woodland is planted with tree species 1 (slow-growing, more resistant).




Share of risky assets: This value shows how the money is invested. There is a choice between a safe savings account and an investment in stocks.

Select the **share** that is invested in the **risky asset**. The remaining amount is invested in a **savings account**.




As a reminder:

**Tree species 1:** This species grows **more slowly** and produces **lower** yields on average. At the same time, it is **more resistant** to pests.

More pest resistance means that yields **hardly fluctuate**.

**Tree species 2:** This species grows **faster** and achieves **higher** yields on average. At the same time, it is **more susceptible** to pests.

Less pest resistance means that yields **fluctuate more**.

As a reminder:

**Option 1:** Saving with a **savings account**.

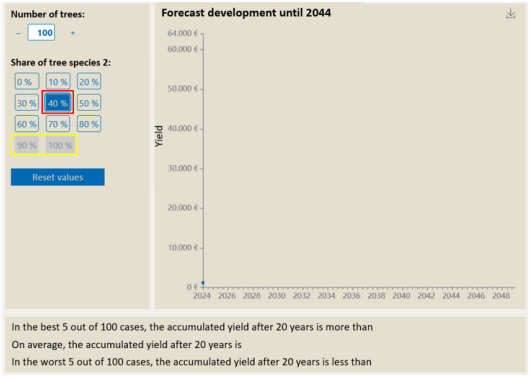
A savings account is a **low-risk** investment that generates **constant returns**. The assets saved do **not fluctuate**, but are **lower** on average as the returns are low.

**Option 2:** Saving with **shares**. Shares are securities with which shareholders acquire shares in companies.

Shares have a **higher risk** and generate **higher returns on average** over a longer period of time. At the same time, the returns and the total value of the assets saved can **fluctuate**.

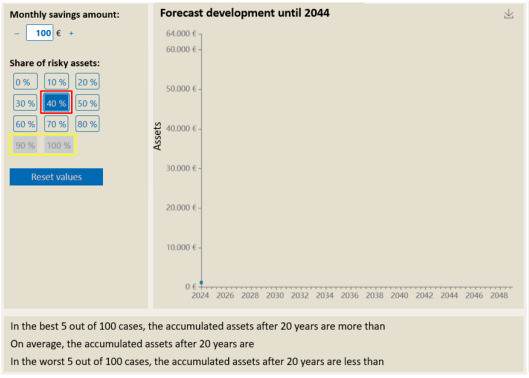
Example: The field marked in red means that tree species 2 is planted on 40% of the area and tree species 1 on the remaining 60%.

Note: The fields marked in yellow with a share of tree species 2 of over 90% are highlighted in gray, as they rarely occur in practice.

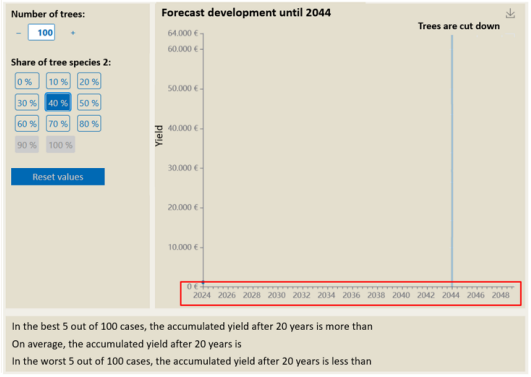



Example: The field marked in red means that 40% of the monthly savings amount is invested in shares and 60% in a savings account.

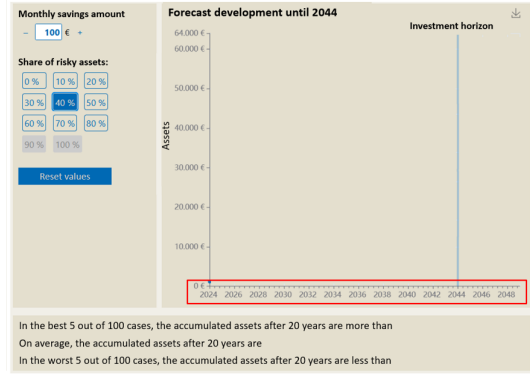
Note: The fields marked in yellow with an equity component of over 90% are highlighted in gray, as they are rarely offered in practice.



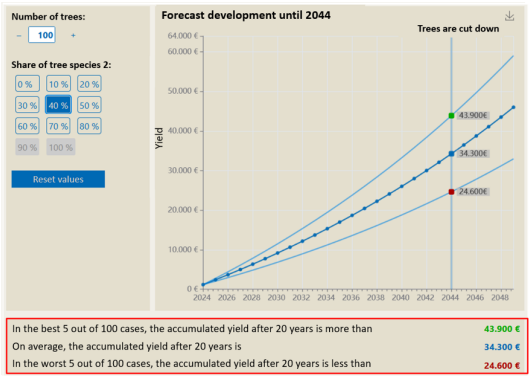

Time horizon: The time horizon describes how long the tree planting project will last.
In all three cases, the time horizon is 20 years.




Investment horizon: The investment horizon describes how long the money is saved for.
In all three cases, the investment horizon is 20 years.

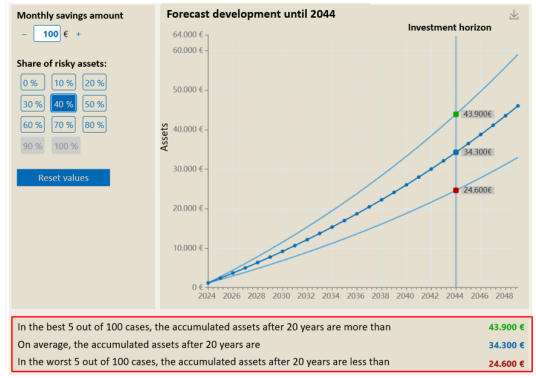


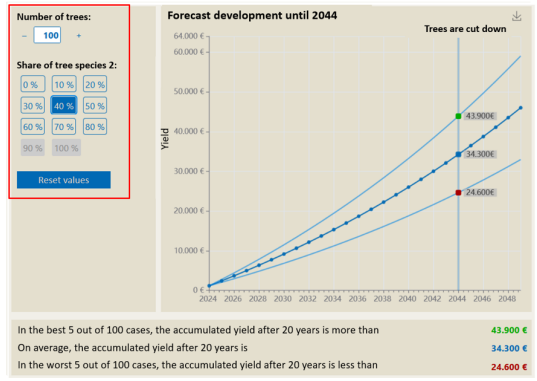
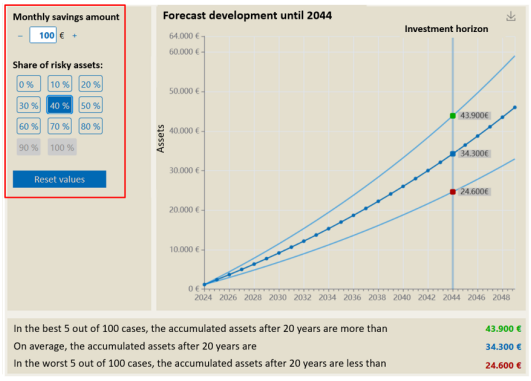

Yield development until 2044: The three cases show possible yield developments over 20 years.




Performance until 2044: The three cases show possible developments over 20 years.

The return on equities is based on projections of the average global performance of the capital markets over the last 25 years.
We assume that the savings account has an annual return of 1%.



| | |
|---|---|
| Summary: You can adjust the number of trees that are planted each year and the proportion of the second tree species.<br>*Try out the interactive graph for yourself.*<br>  | Summary: You can adjust the monthly savings amount and the share of risky assets.<br>*Try out the interactive graph for yourself.*<br>  |

### Step 3: Simulation tool

| **Neutral frame (Group 0 and Group 2)** |
|---|
| ZEW is developing this interactive graph and would like to continuously improve it. We would like to invite you to test the interactive graph and thus contribute to its further development.<br><br>Now you can try out the interactive graph for yourself. Please change the number of trees and the share of tree species 2 to familiarize yourself with the interactive graph.<br><br>[Simulation tool in neutral frame] |
| **Finance frame (Group 1 and Group 3)** |
| ZEW is developing this interactive graph and would like to continuously improve it. We would like to invite you to test the interactive graph and thus contribute to its further development.<br><br>You can now try out the interactive graph for yourself. Please change the savings amount and the share of risky assets to familiarize yourself with the interactive graph.<br><br>[Simulation tool in finance frame] |

### Step 4: Comprehension questions

| **Neutral frame (Group 0 and Group 2)** | |
|---|---|
| **Question** | **Answer options** |
| Comprehension question 1:<br><br>To help you familiarize yourself with the graph, we present three scenarios.<br><br>In the first scenario, we ask you to read a value in the graph. You do not have to adjust any of the values.<br><br><u>Scenario 1:</u><br><br>Mrs. Blau wants to plant 100 trees every year over the duration of the project. She selects a 50% share of tree species 2. | _____ Euro |

| | |
|---|---|
| What is her predicted yield in the **best 5 out of 100 cases**? | |
| How confident are you that your answer is correct? | Please rate using the scale from 0 to 10. 0 means "no confidence" and 10 means "very high confidence"<br>0 "no confidence" to 10 "very high confidence" |
| Comprehension question 2:<br>In scenario 2, we ask you to adjust the share of tree species 2 and then read off the average yield from the graph.<br>Scenario 2: Mr. Lila can plant 100 trees every year. He selects a 70% share of tree species 2.<br>What is his predicted **average yield** at the end of the project? | _____ Euro |
| How confident are you that your answer is correct? | Please rate using the scale from 0 to 10. 0 means "no confidence" and 10 means "very high confidence"<br>0 "no confidence" to 10 "very high confidence" |
| Comprehension question 3:<br>In scenario 3, we ask you to adjust the number of trees. Please pay attention to the changes in the graph.<br>Scenario 3: Mrs. Gelb is willing to plant 50% of tree species 2 in her forest. During the project, she would like to achieve a yield of 30,500 Euro in the **worst 5 out of 100 cases**.<br>How many trees must she plant each year in order to achieve this in the **worst 5 out of 100 cases**? | _____ trees |
| How confident are you that your answer is correct? | Please rate using the scale from 0 to 10. 0 means "no confidence" and 10 means "very high confidence"<br>0 "no confidence" to 10 "very high confidence" |

| **Finance frame (Group 1 and Group 3)** | |
|---|---|
| **Question** | **Answer options** |
| Comprehension question 1:<br>To help you familiarize yourself with the graph, we present three scenarios.<br>In the first scenario, we ask you to read a value in the graph. You do not have to adjust any of the values.<br>Scenario 1: Mrs. Blau would like to invest a monthly savings amount of 100 Euro over a | _____ Euro |

| | |
|---|---|
| period of 20 years. She chooses an equity share of 50%.<br>How high are her projected assets in the **best 5 out of 100 cases**? | |
| How confident are you that your answer is correct? | Please rate using the scale from 0 to 10. 0 means "no confidence" and 10 means "very high confidence"<br>0 "no confidence" to 10 "very high confidence" |
| Comprehension question 2:<br>In scenario 2, we ask you to adjust the share of the risky asset and then read off the average assets from the graph.<br>Scenario 2: Mr. Lila can set aside 100 Euro per month. He selects an equity share of 70%.<br>What is his projected **average wealth** after 20 years? | _____ Euro |
| How confident are you that your answer is correct? | Please rate using the scale from 0 to 10. 0 means "no confidence" and 10 means "very high confidence"<br>0 "no confidence" to 10 "very high confidence" |
| Comprehension question 3:<br>In scenario 3, we ask you to adjust the monthly savings amount. Please pay attention to the changes in the graph.<br>Scenario 3: Mrs. Gelb is prepared to accept a 50% share of equities in her portfolio. She would like to build up assets of 43,500 Euro in 20 years in the **worst 5 out of 100 cases**.<br>How much money must she save each month in order to achieve this in the **worst 5 out of 100 cases**? | _____ Euro |
| How confident are you that your answer is correct? | Please rate using the scale from 0 to 10. 0 means "no confidence" and 10 means "very high confidence"<br>0 "no confidence" to 10 "very high confidence" |

**Step 5: Final decision (only in finance frame)**

| **Finance frame (Group 1 and Group 3)** | |
|---|---|
| **Question** | **Answer options** |
| Please think about your own financial situation. Which values would you choose for yourself in the interactive graph? | Log in to the interactive graph ("Save values and continue") |

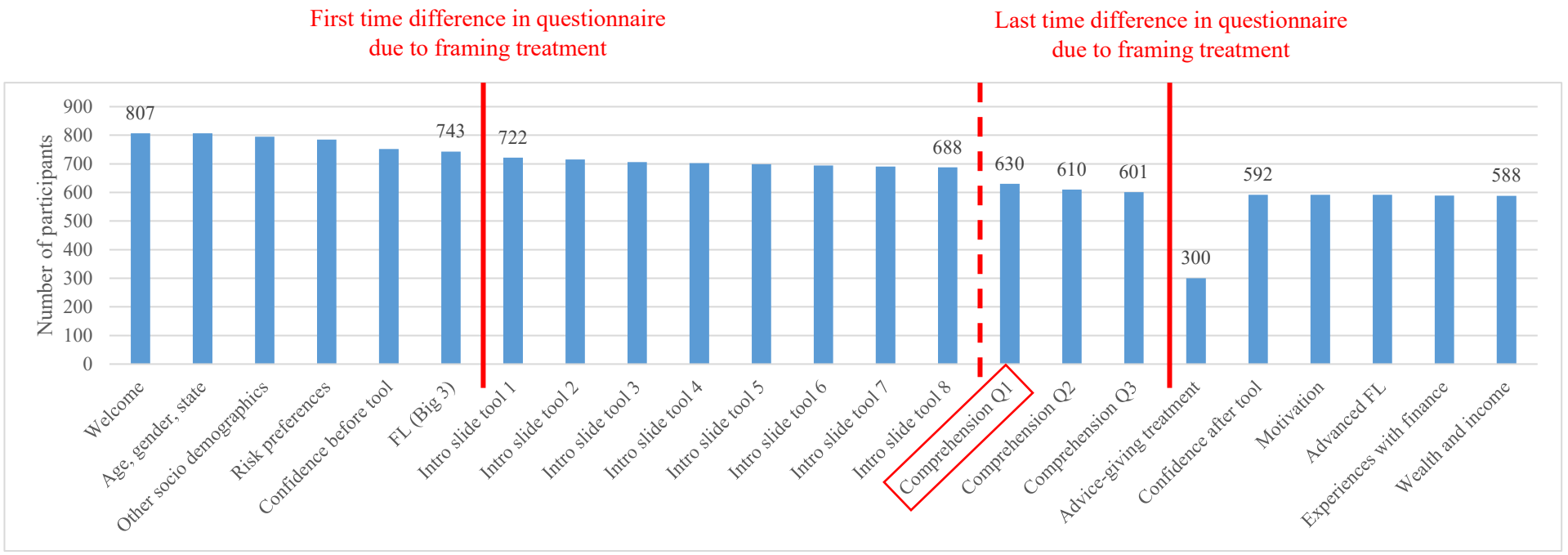
**Step 6: General feedback (All)**

| Question | Answer options |
|---|---|
| To what extent do you agree with the following statements:<br>The graphical representation in the interactive graph is understandable. | Please rate on a scale from 0 to 10. 0 means "does not apply at all" and 10 means "fully applies". |
| The graphical representation in the interactive graph is helpful. | 0 "does not apply at all" to 10 o "fully applies" |
| The graphical representation in the interactive graph is complicated. | 0 "does not apply at all" to 10 o "fully applies" |
| I feel well informed by the scenarios shown in the interactive graph. | 0 "does not apply at all" to 10 o "fully applies" |
| Do you have any further comments on the presentation in the interactive graph? | *[Open field]* |

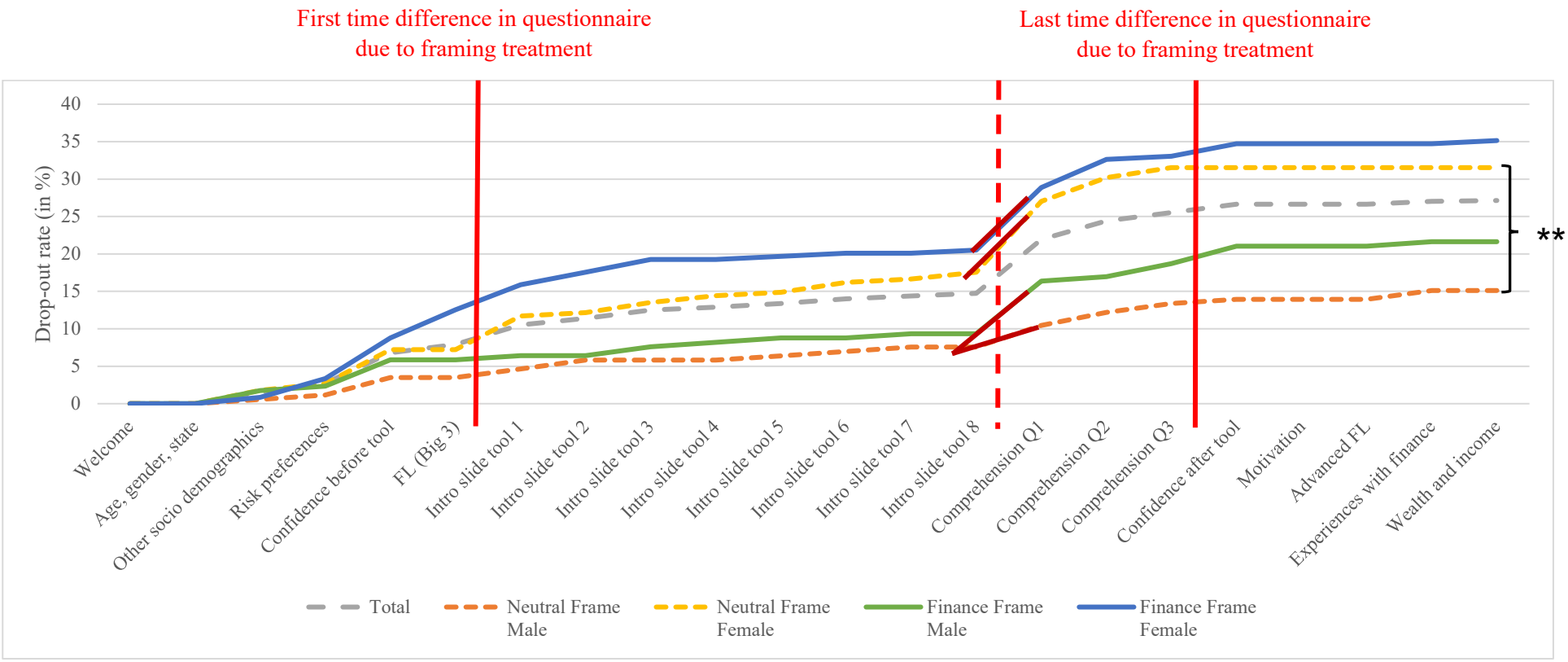
**Appendix C: Additional figures and tables**

**Figure A1: Drop-out rates**

**Panel A:** Absolute number of participants during the survey

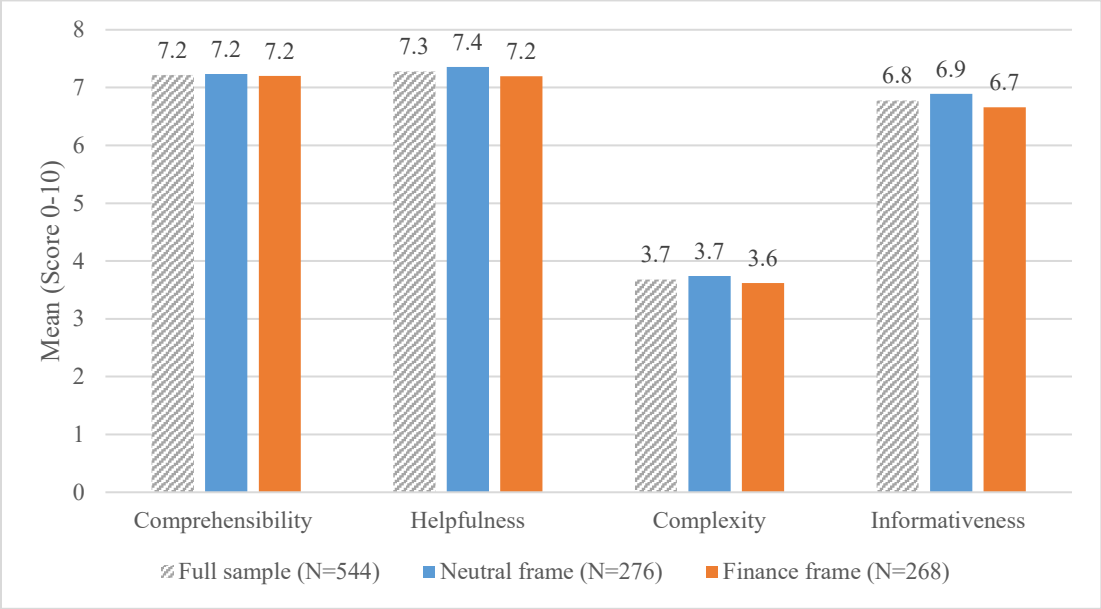


**Panel B:** Drop-out rates by framing treatment and gender




Notes: Figure A1, Panel A shows the absolute number of participants during the survey. Panel B shows the drop-out rates by framing treatment and by gender. N=807.

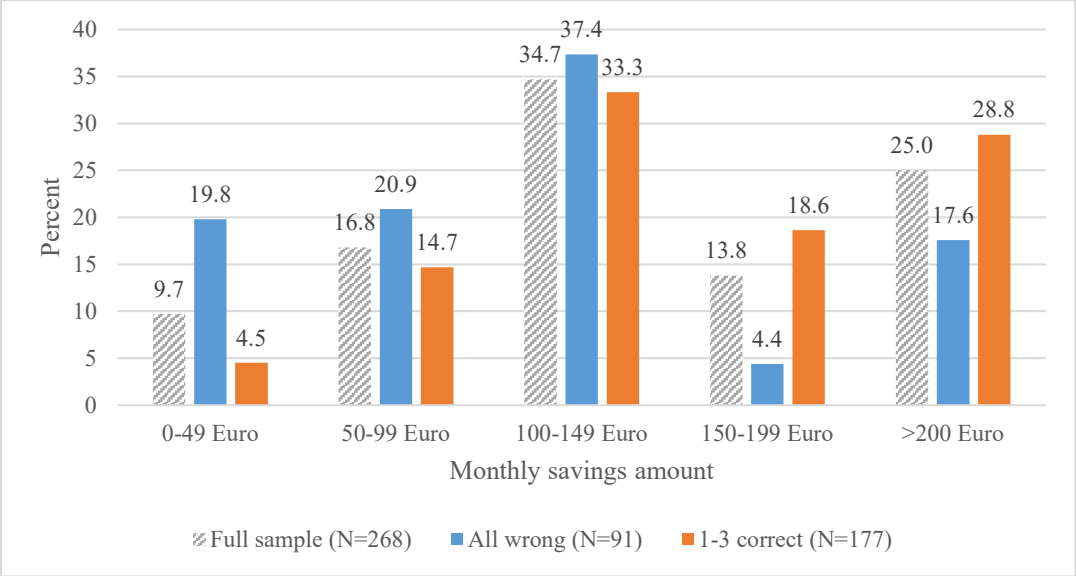
**Figure A2: Feedback questions by framing treatment**



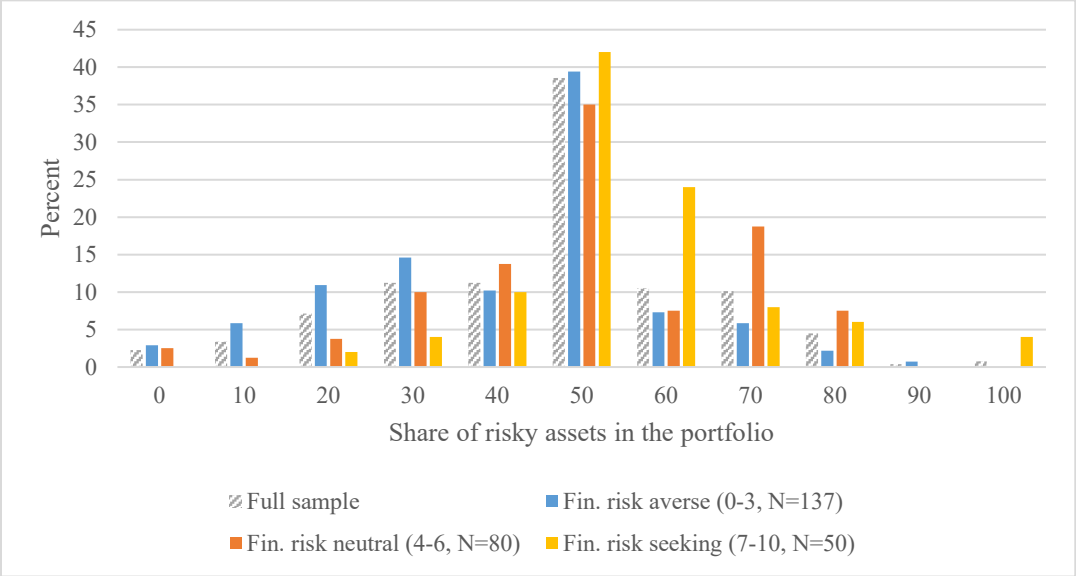

Notes: Figure A2 shows the mean scores of the four feedback questions by framing treatment. The four feedback questions read: *"To what extent do you agree with the following statements: The graphical representation in the interactive graph is 1) understandable, 2) helpful, 3) complicated. 4) I feel well informed by the scenarios shown in the interactive graph."* (Scale from 0 meaning "does not apply at all" to 10 meaning "fully applies"). N=544.

**Figure A3: Final decision in finance frame**

**Panel A:** Monthly savings amount by tool comprehension

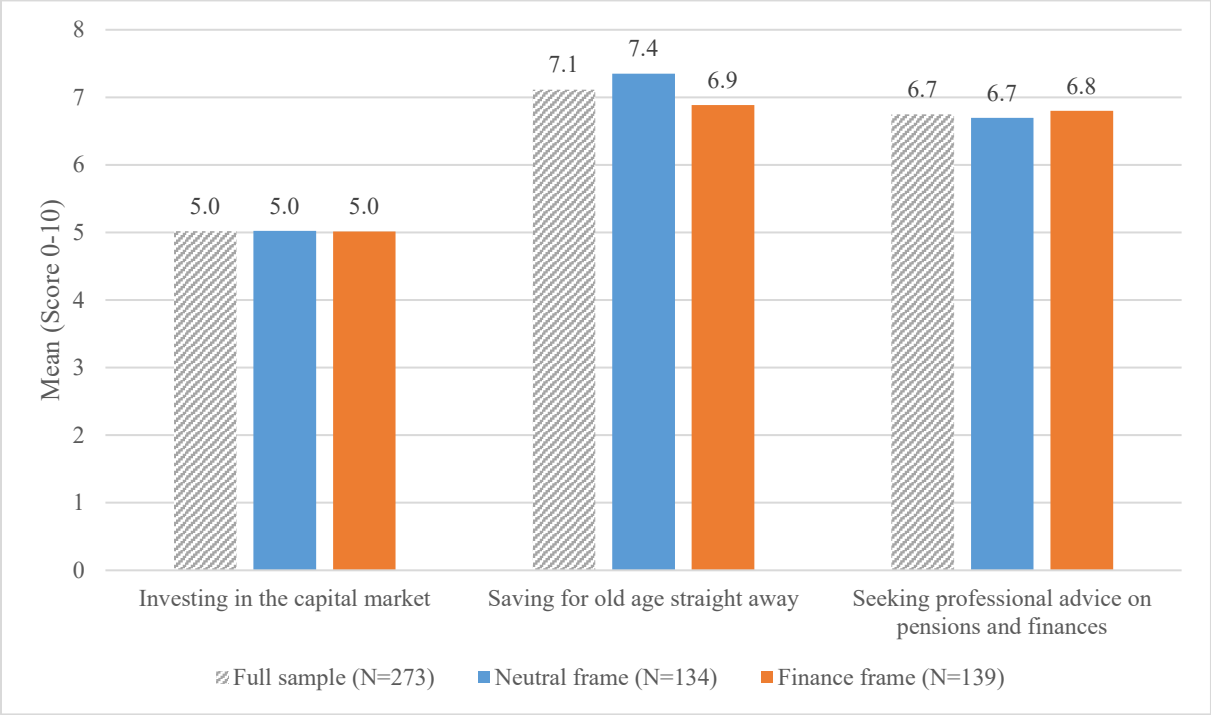



**Panel B:** Share of risky assets by financial risk tolerance (N=267)




Notes: Figure A3, Panel A show the monthly savings amounts chosen by participants in the finance frame by tool comprehension. It differentiates between participants who answer all comprehension questions wrongly and those who answer one to three questions correctly. The original question reads: *"Please think about your own financial situation. Which values would you choose for yourself in the interactive graph?"* Panel B shows the share of risky assets in the portfolio chosen by participants in the finance frame by financial risk tolerance (N=267). Financial risk tolerance is originally defined on a scale from 0 meaning "Not at all willing to take risks" to 10 meaning "Very willing to take risks". In the figure, the scale is condensed to three groups: "Fin. risk averse (0-3), "Fin. risk neutral (4-6)", and "Fin. risk seeking" (7-10).

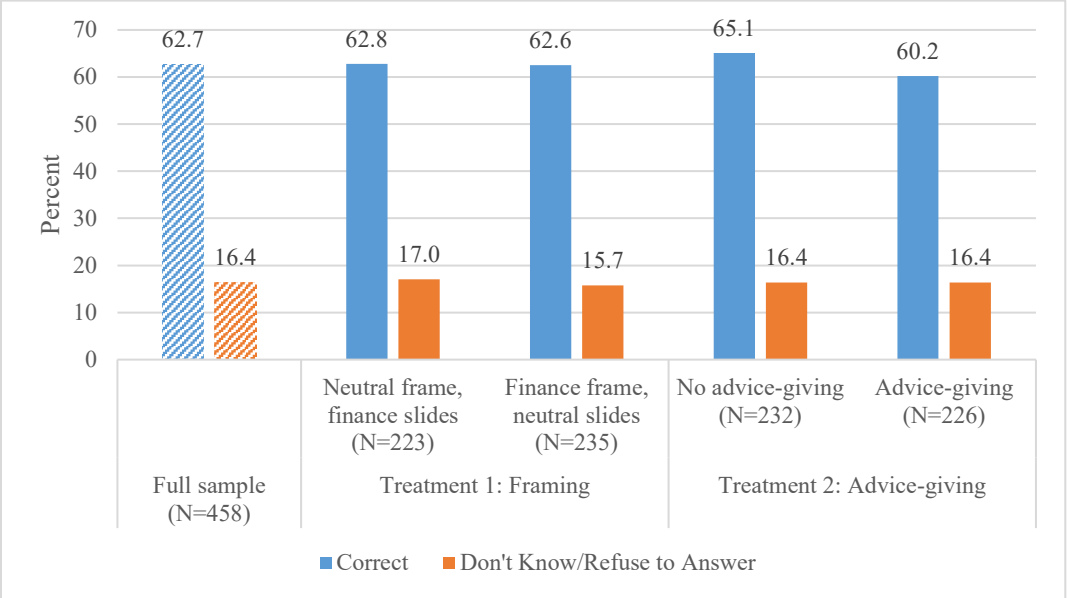
**Figure A4: Advice-giving task (closed form questions)**



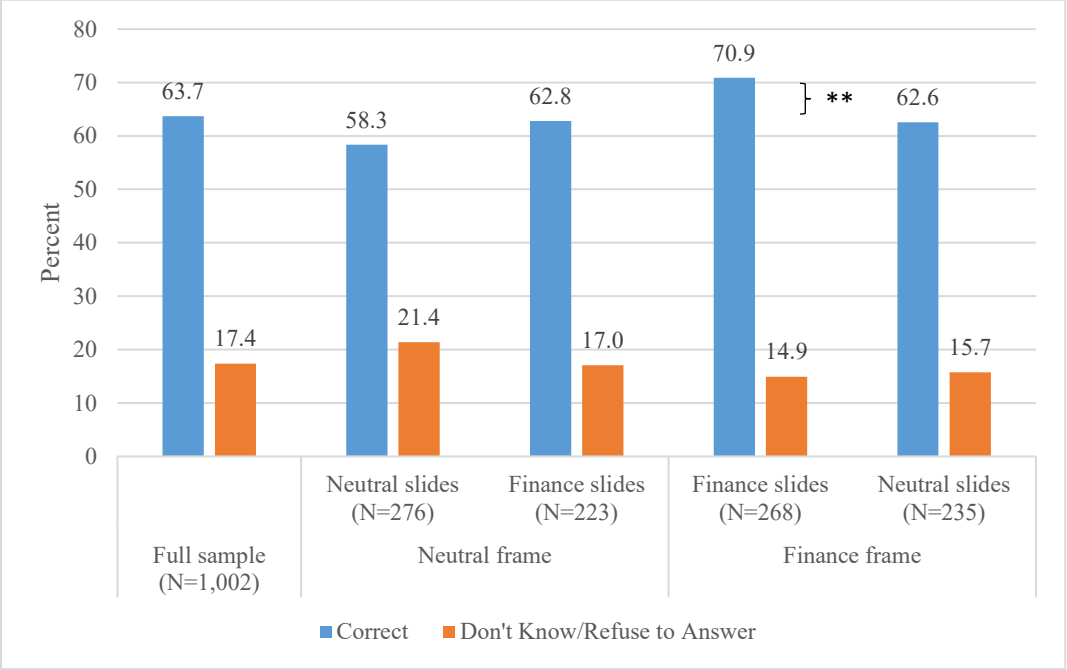

Notes: Figure A4 shows the mean results for the three closed form questions in the advice-giving treatment by framing treatment. The original questions read: *1) Would you recommend investing in the capital market to a friend? 2) Please think of a friend who is just starting out in working life. Would you advise him or her to start saving for old age straight away? 3) Please think of a friend who has no experience with pensions and finances. Would you recommend that a friend seek professional advice on pensions and finances?* The answer scale to the closed questions is defined from 0 meaning "Not recommend at all" to 10 meaning "Highly recommend". N=273.

**Figure A5: FL5 – Mechanism analyses**

**Panel A:** FL5 Volatility of returns by framing treatment and advice-giving treatment in mismatched sample



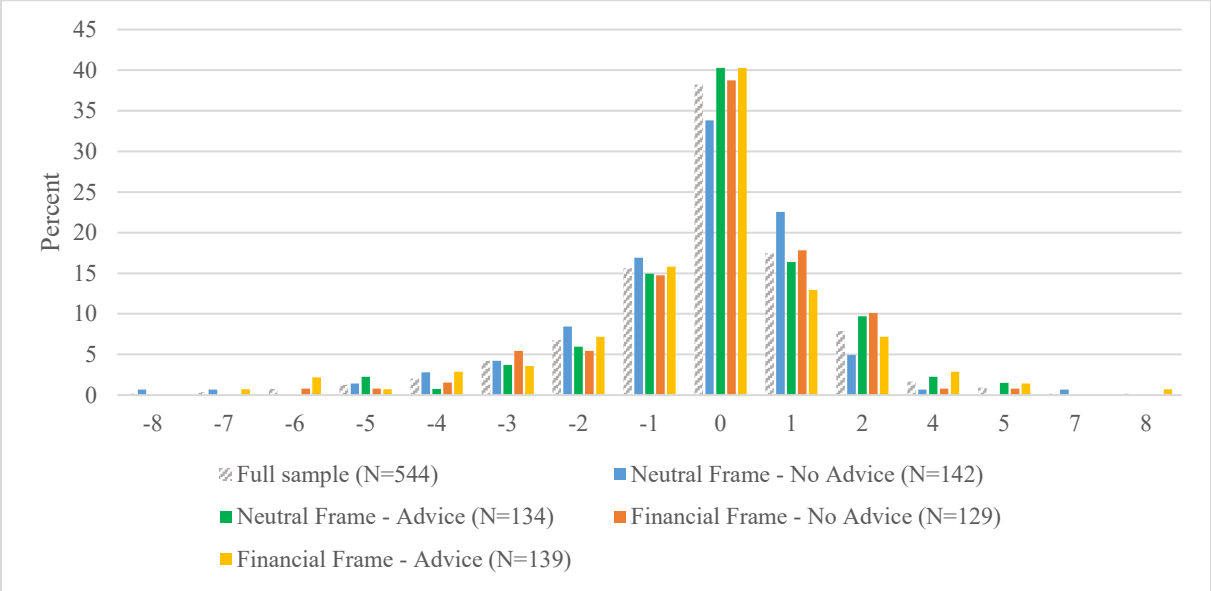

**Panel B:** FL5 Volatility of returns by corrected framing treatment



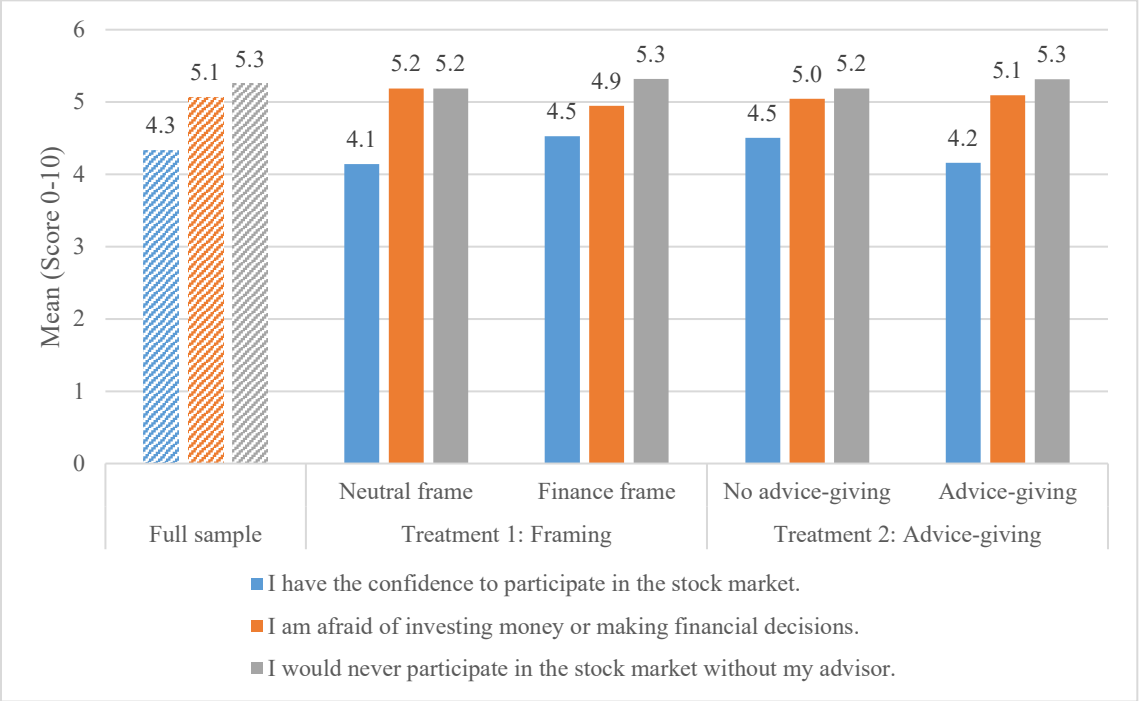

Notes: Figure A5, Panel A shows the results for FL5 by framing treatment and by advice-giving treatment separately in the mismatched sample (N=458). Panel D shows the results for FL5 by corrected treatment, i.e., both the correct framing treatment and the mismatched framing treatment (N=1,002). T-tests are used to test differences between groups. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

**Figure A6: Confidence – Additional definitions**

**Panel A:** Difference in confidence before and after the experiment – 2x2 design

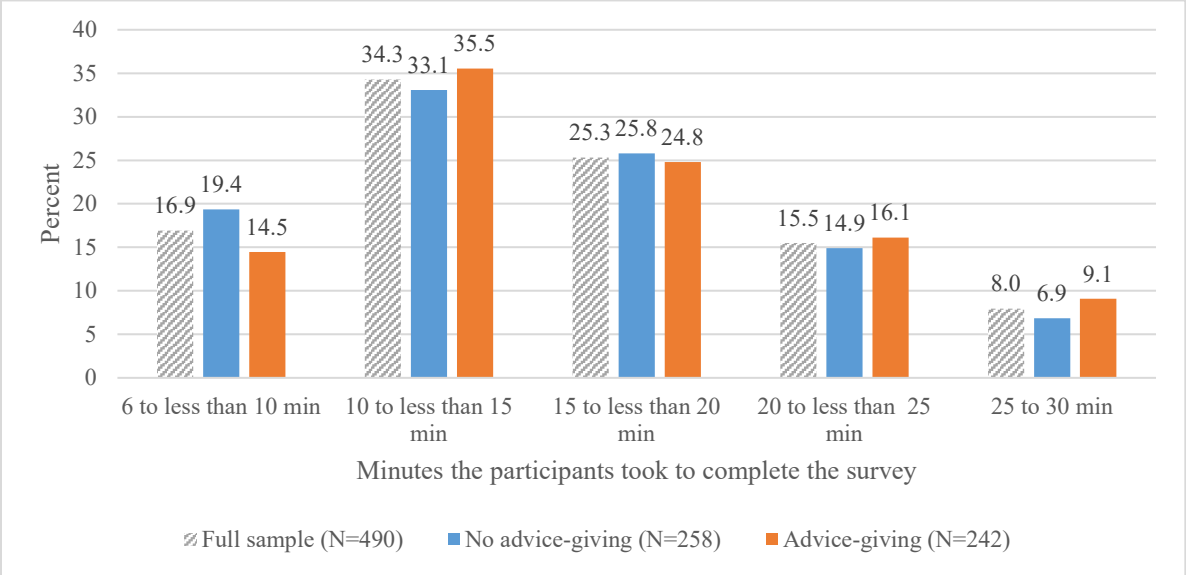



**Panel B:** Indirect measure of confidence by framing and advice-giving treatment




Notes: Figure A6 shows the results for additional confidence measures. Panel A displays the difference in confidence before and after the experiment in the 2x2 between-subjects design. Panel B shows the mean scores to the three indirect confidence questions by framing treatment and advice-giving treatment separately. The answer scale for all three statements is defined from 0 meaning "fully disagree" to 10 meaning "fully agree". N=544.

**Figure A7: Fatigue**




Notes: Figure A7 displays the time participants needed to complete the survey. N=54 taking more than 30 minutes to complete the survey are excluded to avoid confounding factors such as taking a break while completing the survey. N=490.

**Table A1: Comprehension questions by confidence that respective answer is correct**

Table A1 shows the results of the three comprehension questions by confidence levels that the respective comprehension question is answered correctly. The original question reads: *"How sure are you that your answer is correct?"* (Scale from 0 meaning "not sure" to 10 meaning "very sure"). In the table, the scale is condensed to three groups: "Not sure (0-3), "Neutral (4-6)", and "Very sure" (7-10).

| | Wrong | | Correct | | Full sample | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Dummy correct Q1 (both frames) | | | | | | |
| Full sample | 228 | 100 | 316 | 100 | 544 | 100 |
| Not sure (0-3) | 102 | 44.74 | 19 | 6.01 | 121 | 22.24 |
| Neutral (4-6) | 64 | 28.07 | 39 | 12.34 | 103 | 18.93 |
| Very sure (7-10) | 62 | 27.19 | 258 | 81.65 | 320 | 58.82 |
| Dummy correct Q2 (both frames) | | | | | | |
| Full sample | 236 | 100 | 308 | 100 | 544 | 100 |
| Not sure (0-3) | 98 | 41.53 | 15 | 4.87 | 113 | 20.77 |
| Neutral (4-6) | 62 | 26.27 | 22 | 7.14 | 84 | 15.44 |
| Very sure (7-10) | 76 | 32.2 | 271 | 87.99 | 347 | 63.79 |
| Dummy correct Q3 (both frames) | | | | | | |
| Full sample | 262 | 100 | 282 | 100 | 544 | 100 |
| Not sure (0-3) | 124 | 47.33 | 4 | 1.42 | 128 | 23.53 |
| Neutral (4-6) | 72 | 27.48 | 14 | 4.96 | 86 | 15.81 |
| Very sure (7-10) | 66 | 25.19 | 264 | 93.62 | 330 | 60.66 |

**Table A2: Financial literacy questions**

Table A2 contains an overview of the financial literacy questions implemented during the survey. FL1 to FL3 are asked before the experiment. FL4 to FL6 are asked after the experiment. The correct answers are shown in bolt.

| | N | % |
|---|---|---|
| **Before the experiment** | | |
| Panel A: FL1 Interest | | |
| **More than 102 Euro** | 427 | 78.49 |
| Exactly 102 Euro | 28 | 5.15 |
| Less than 102 Euro | 46 | 8.46 |
| Do not know | 38 | 6.99 |
| Refuse to answer | 5 | 0.92 |
| Panel B: FL2 Inflation | | |
| More | 21 | 3.86 |
| Exactly the same | 40 | 7.35 |
| **Less than today** | 411 | 75.55 |
| Do not know | 60 | 11.03 |
| Refuse to answer | 12 | 2.21 |
| Panel C: FL3 Risk diversification | | |
| Agree | 56 | 10.29 |
| **Disagree** | 331 | 60.85 |
| Do not know | 133 | 24.45 |
| Refuse to answer | 24 | 4.41 |
| **After the experiment** | | |
| Panel D: FL4 Purpose of stock market | | |
| The stock market helps to predict share profits | 65 | 11.95 |
| The stock market leads to an increase in share prices | 35 | 6.43 |
| **The stock market brings buyers and sellers of shares together** | 324 | 59.56 |
| None of these | 38 | 6.99 |
| Do not know | 60 | 11.03 |
| Refuse to answer | 22 | 4.04 |
| Panel E: FL5 Volatility of returns | | |
| Savings accounts | 30 | 5.51 |
| Fixed-term deposits | 24 | 4.41 |
| Fixed-interest securities | 40 | 7.35 |
| **Shares** | 351 | 64.52 |
| Do not know | 67 | 12.32 |
| Refuse to answer | 32 | 5.88 |
| Panel F: FL6 Comprehending risk | | |
| **The car repair** | 260 | 47.79 |
| The air conditioning replacement | 124 | 22.79 |
| There is no way to tell in advance | 96 | 17.65 |
| Do not know | 52 | 9.56 |
| Refuse to answer | 12 | 2.21 |
| Total number of observations | 544 | 100 |

**Table A2: Financial literacy questions (continued)**

| | N | % |
|---|---|---|
| **Before the experiment** | | |
| Correct answers to interest and inflation (FL 1 and 2 correct) | 355 | 65.26 |
| "Big Three" correct | 263 | 48.35 |
| None of the "Big Three" correct | 53 | 9.74 |
| At least one "Big Three" "Do Not Know" | 182 | 33.46 |
| All "Big Three" "Do Not Know" | 29 | 5.33 |
| **After the experiment** | | |
| FL 4 and 6 correct | 175 | 32.17 |
| FL 4 or 6 correct | 409 | 75.18 |
| FL 4, 5, and 6 correct | 143 | 26.29 |
| Total number of observations | 544 | 100 |

**Table A3: Correlation table for financial literacy**

Table A3 shows the correlation between the financial literacy questions and other important variables.

| | FL1 | FL2 | FL3 | FL4 | FL5 | **FL6** | "Big Three" | Female | Age | Risk tol. | Stocks/ ETF | HH income | Educ. | Conf. before |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FL1: Interest | 1 | 0.34 | 0.25 | 0.29 | 0.23 | **0.13** | 0.51 | -0.09 | 0.01 | -0.11 | 0.17 | 0.09 | 0.23 | 0.03 |
| FL2: Inflation | 0.34 | 1 | 0.43 | 0.28 | 0.27 | **0.13** | 0.55 | -0.02 | 0.07 | -0.02 | 0.16 | 0.13 | 0.23 | 0.04 |
| FL3: Risk diversification | 0.25 | 0.43 | 1 | 0.41 | 0.30 | **0.09** | 0.78 | -0.00 | 0.04 | -0.10 | 0.28 | 0.11 | 0.27 | 0.09 |
| FL4: Stock market (correct dummy) | 0.29 | 0.28 | 0.41 | 1 | 0.37 | **0.15** | 0.44 | -0.05 | 0.10 | -0.11 | 0.29 | 0.11 | 0.25 | 0.16 |
| FL5: Volatility of returns (correct dummy) | 0.23 | 0.27 | 0.30 | 0.37 | 1 | **0.13** | 0.35 | 0.01 | 0.06 | -0.11 | 0.21 | 0.10 | 0.20 | 0.08 |
| **FL6: Comprehending risk (correct dummy)** | **0.13** | **0.12** | **0.10** | **0.15** | **0.12** | **1** | **0.15** | **-0.01** | **-0.01** | **-0.01** | **0.14** | **0.14** | **0.21** | **0.08** |
| Big Three correct | 0.51 | 0.55 | 0.78 | 0.44 | 0.35 | **0.15** | 1 | -0.05 | 0.07 | -0.11 | 0.28 | 0.20 | 0.30 | 0.07 |
| Female | -0.09 | -0.02 | -0.00 | -0.05 | 0.01 | **-0.01** | -0.05 | 1 | 0.05 | -0.20 | -0.05 | 0.01 | 0.09 | -0.06 |
| Age (in years) | 0.02 | 0.07 | 0.05 | 0.11 | 0.07 | **-0.01** | 0.08 | 0.04 | 1 | -0.11 | -0.00 | 0.01 | -0.29 | -0.01 |
| Risk tolerance (0-10) | -0.11 | -0.02 | -0.10 | -0.11 | -0.11 | **0.01** | -0.11 | -0.21 | -0.12 | 1 | 0.13 | 0.01 | 0.01 | 0.24 |
| Stocks/ ETFs ownership | 0.17 | 0.16 | 0.28 | 0.28 | 0.21 | **0.13** | 0.27 | -0.05 | -0.00 | 0.14 | 1 | 0.27 | 0.24 | 0.19 |
| HH income dummy | 0.07 | 0.11 | 0.09 | 0.08 | 0.08 | **0.13** | 0.17 | 0.01 | -0.00 | 0.01 | 0.25 | 1 | 0.27 | 0.04 |
| Level of education | 0.22 | 0.24 | 0.28 | 0.25 | 0.21 | **0.22** | 0.31 | 0.09 | -0.27 | 0.01 | 0.25 | 0.26 | 1 | 0.11 |
| Conf. bef. exp. (0-10) | 0.02 | 0.03 | 0.09 | 0.15 | 0.07 | **0.10** | 0.07 | -0.07 | -0.01 | 0.28 | 0.19 | 0.03 | 0.11 | 1 |

**Table A4: OLS regression results for financial knowledge – Additional definitions**

This table reports the OLS estimates of the effect of the framing treatment, the advice-giving treatment and several control variables on additional financial literacy measures. The dependent variables are (i) a dummy that equals 1 if the participant is able to answer at least one of FL4 and FL6 correctly, 0 otherwise (Columns 1 and 2), (ii) a dummy that equals 1 if the participant is able to answer both FL4 and FL6 correctly, 0 otherwise (Columns 3 and 4), (iii) the number of correct answers to the three advanced financial literacy questions (Columns 5 and 6), and (iv) the self-assessed financial literacy score (Columns 7-9). Robust standard errors are shown in parentheses. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | Dummy =1 if at least one of FL4 and FL6 correct, 0 otherwise | | Dummy =1 if both FL4 and FL6 correct, 0 otherwise | | FL score (0-3, after) | | Self-assessed FL (0-6) | | |
| Framing treatment: Finance frame | 0.00526 | -0.00898 | -0.0573 | -0.0711* | 0.0742 | 0.0310 | 0.0225 | -0.0812 | -0.0623 |
| | (0.0371) | (0.0338) | (0.0399) | (0.0378) | (0.0867) | (0.0738) | (0.164) | (0.141) | (0.138) |
| Advice treatment: Giving advice | -0.0461 | -0.0432 | -0.0924** | -0.0877** | -0.158* | -0.168** | -0.185 | -0.0599 | -0.0584 |
| | (0.0371) | (0.0338) | (0.0399) | (0.0380) | (0.0868) | (0.0746) | (0.164) | (0.143) | (0.141) |
| Female | | -0.0412 | | -0.0530 | | -0.0950 | | -0.340** | -0.316** |
| | | (0.0345) | | (0.0395) | | (0.0773) | | (0.151) | (0.144) |
| Age (in years) | | 0.00310* | | 0.00346* | | 0.00908** | | -0.0133* | -0.0182** |
| | | (0.00175) | | (0.00187) | | (0.00380) | | (0.00721) | (0.00716) |
| Risk tolerance (0-10) | | -0.0140* | | -0.0177** | | -0.0478*** | | 0.0926*** | 0.101*** |
| | | (0.00736) | | (0.00819) | | (0.0159) | | (0.0329) | (0.0328) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | | | | | | |
| 2,000 to less than 3,500 Euro | | -0.0221 | | -0.0375 | | -0.0588 | | 0.0475 | 0.104 |
| | | (0.0538) | | (0.0529) | | (0.116) | | (0.221) | (0.206) |
| 3,500 to less than 5,000 Euro | | 0.0263 | | 0.0855 | | 0.169 | | 0.293 | 0.259 |
| | | (0.0532) | | (0.0610) | | (0.121) | | (0.250) | (0.242) |
| 5,000 Euro and more | | 0.0524 | | 0.120* | | 0.216* | | 0.0307 | -0.00456 |
| | | (0.0539) | | (0.0637) | | (0.125) | | (0.238) | (0.230) |

**Table A4 (continued)**

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Dummy =1 if at least one of FL4 and FL6 correct, 0 otherwise | | Dummy =1 if both FL4 and FL6 correct, 0 otherwise | | FL score (0-3, after) | | Self-assessed FL (0-6) | | |
| Not specified | | -0.115 | | -0.0601 | | -0.305* | | -0.385 | -0.314 |
| | | (0.0805) | | (0.0657) | | (0.157) | | (0.307) | (0.274) |
| *Reference category: Low education level* | | | | | | | | | |
| Medium education level | | 0.110* | | 0.111** | | 0.369*** | | 0.254 | 0.0593 |
| | | (0.0595) | | (0.0487) | | (0.116) | | (0.258) | (0.255) |
| High education level | | 0.210*** | | 0.201*** | | 0.570*** | | 0.582** | 0.323 |
| | | (0.0569) | | (0.0543) | | (0.119) | | (0.255) | (0.258) |
| Conf. to make good fin. decisions bef. exp. (0-10) | | 0.0262*** | | 0.0203** | | 0.0582*** | | 0.219*** | 0.206*** |
| | | (0.00893) | | (0.00907) | | (0.0187) | | (0.0397) | (0.0385) |
| "Big Three" correct | | 0.235*** | | 0.173*** | | 0.671*** | | 0.941*** | |
| | | (0.0363) | | (0.0428) | | (0.0837) | | (0.170) | |
| East dummy | | 0.0520 | | 0.0250 | | -0.0128 | | -0.321* | -0.329* |
| | | (0.0413) | | (0.0455) | | (0.0868) | | (0.174) | (0.173) |
| Financial literacy score (0-6) | | | | | | | | | 0.353*** |
| | | | | | | | | | (0.0569) |
| Constant | 0.772*** | 0.311*** | 0.396*** | 0.00375 | 1.762*** | 0.596*** | 3.846*** | 1.537*** | 0.995** |
| | (0.0312) | (0.115) | (0.0354) | (0.109) | (0.0752) | (0.229) | (0.140) | (0.474) | (0.477) |
| Observations | 544 | 543 | 544 | 543 | 544 | 543 | 433 | 433 | 433 |
| R-squared | 0.003 | 0.205 | 0.014 | 0.159 | 0.007 | 0.303 | 0.003 | 0.291 | 0.316 |

**Table A5: OLS regression results for financial knowledge – Additional specification**

This table reports the OLS estimates of the effect of the framing treatment, the advice-giving treatment, the interaction of the two treatments and several control variables on financial literacy after the experiment. The dependent variable is a dummy that equals 1 if the respective financial literacy question is answered correctly, 0 otherwise. Moreover, it shows whether the overall interaction effect, i.e., $\beta_1 + \beta_2 + \beta_3$, is statistically significantly different from zero. Robust standard errors are shown in parentheses. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | FL4: Stock market | | FL5: Volatility of returns | | FL6: Comprehending risk | |
| Framing treatment: Finance frame | 0.0152 | -0.0415 | 0.115** | 0.0779 | -0.0680 | -0.0818 |
| | (0.0592) | (0.0533) | (0.0575) | (0.0540) | (0.0608) | (0.0594) |
| Advice treatment: Giving advice | -0.0530 | -0.0980* | -0.0314 | -0.0690 | -0.0862 | -0.0752 |
| | (0.0595) | (0.0506) | (0.0596) | (0.0540) | (0.0602) | (0.0585) |
| Finance frame x Giving Advice | 0.00780 | 0.0711 | 0.0233 | 0.0656 | -0.00650 | 0.0148 |
| | (0.0844) | (0.0753) | (0.0816) | (0.0762) | (0.0855) | (0.0845) |
| Female | | -0.0673* | | -0.000707 | | -0.0268 |
| | | (0.0385) | | (0.0399) | | (0.0430) |
| Age (in years) | | 0.00494** | | 0.00256 | | 0.00166 |
| | | (0.00195) | | (0.00199) | | (0.00208) |
| Risk tolerance (0-10) | | -0.0242*** | | -0.0156* | | -0.00661 |
| | | (0.00808) | | (0.00873) | | (0.00922) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | | | |
| 2,000 to less than 3,500 Euro | | 0.0223 | | 0.00372 | | -0.0782 |
| | | (0.0577) | | (0.0586) | | (0.0614) |
| 3,500 to less than 5,000 Euro | | 0.0559 | | 0.0563 | | 0.0548 |
| | | (0.0627) | | (0.0601) | | (0.0661) |
| 5,000 Euro and more | | 0.0379 | | 0.0423 | | 0.134* |
| | | (0.0637) | | (0.0643) | | (0.0687) |
| Not specified | | -0.137* | | -0.128* | | -0.0367 |
| | | (0.0742) | | (0.0774) | | (0.0862) |
| *Reference category: Low education level* | | | | | | |
| Medium education level | | 0.0906 | | 0.153** | | 0.136** |
| | | (0.0577) | | (0.0621) | | (0.0635) |
| High education level | | 0.187*** | | 0.162** | | 0.227*** |
| | | (0.0602) | | (0.0631) | | (0.0638) |
| Conf. to make good fin. decisions bef. exp. (0-10) | | 0.0289*** | | 0.0118 | | 0.0177* |
| | | (0.00999) | | (0.00997) | | (0.0104) |
| "Big Three" correct | | 0.340*** | | 0.265*** | | 0.0710 |
| | | (0.0430) | | (0.0427) | | (0.0456) |
| East dummy | | 0.0348 | | -0.0887** | | 0.0434 |
| | | (0.0464) | | (0.0451) | | (0.0498) |
| Constant | 0.613*** | 0.123 | 0.599*** | 0.288** | 0.556*** | 0.200 |
| | (0.0410) | (0.120) | (0.0413) | (0.128) | (0.0418) | (0.126) |
| Observations | 544 | 543 | 544 | 543 | 544 | 543 |
| R-squared | 0.003 | 0.259 | 0.018 | 0.180 | 0.014 | 0.097 |

**Table A5 (continued)**

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | FL4: Stock market | | FL5: Volatility of returns | | FL6: Comprehending risk | |
| Overall interaction effect | not sign. | not sign. | significant | not sign. | significant | significant |
| | F(1, 540) = 0.26<br>Prob > F = 0.6102 | F(1, 527) = 1.57<br>Prob > F = 0.2111 | F(1, 540) = 3.53<br>Prob > F = 0.0609 | F(1, 527) = 1.89<br>Prob > F = 0.1703 | F(1, 540) = 7.41<br>Prob > F = 0.0067 | F(1, 527) = 6.04<br>Prob > F = 0.0143 |

**Table A6: Randomization with regard to desktop users (mismatched intro) versus smartphone users (correct intro)**

Table A6 contains the randomization tests between desktop users who receive mismatched introduction slides and smartphone users who receive correct introduction slides. Columns 1 and 2 show the mean and standard deviation (sd) for the full sample, respectively. Columns 3 and 4 shows the mean of desktop users' and smartphone users' characteristics, respectively. Column 5 contains the difference between the two groups (Delta). Column 6 reports the T-statistic (T-stat) in parentheses indicating whether the delta is statistically significantly different from zero. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

| | Full sample | | Deskop users | Smartphone users | Mismatched vs. correct intro | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | mean | sd | mean | mean | Delta | T-stat |
| ***Demographics*** | | | | | | |
| Female dummy | 0.487 | 0.500 | 0.444 | 0.523 | -0.079** | (-2.490) |
| Age in years | 37.637 | 10.714 | 38.384 | 37.007 | 1.377** | (2.029) |
| Household size | 2.651 | 1.339 | 2.596 | 2.697 | -0.101 | (-1.193) |
| HH disposable income (in Euro), with non-response | | | | | | |
| Less than 2,000 Euro | 0.269 | 0.444 | 0.264 | 0.274 | -0.010 | (-0.345) |
| 2,000 to less than 3,500 Euro | 0.247 | 0.431 | 0.245 | 0.248 | -0.004 | (-0.132) |
| 3,500 to less than 5,000 Euro | 0.226 | 0.418 | 0.242 | 0.211 | 0.031 | (1.163) |
| 5,000 Euro and more | 0.184 | 0.387 | 0.181 | 0.186 | -0.004 | (-0.181) |
| Not specified | 0.075 | 0.263 | 0.068 | 0.081 | -0.013 | (-0.796) |
| Marital status | | | | | | |
| Single, living alone | 0.365 | 0.482 | 0.369 | 0.362 | 0.007 | (0.224) |
| Single, living together | 0.140 | 0.347 | 0.131 | 0.147 | -0.016 | (-0.733) |
| Married, living together | 0.420 | 0.494 | 0.428 | 0.414 | 0.014 | (0.458) |
| Divorced/separated/widowed, living alone | 0.061 | 0.239 | 0.061 | 0.061 | 0.000 | (0.031) |
| Divorced/separated/widowed, living together | 0.014 | 0.117 | 0.011 | 0.017 | -0.006 | (-0.769) |
| Education dummy | | | | | | |
| Low | 0.170 | 0.376 | 0.144 | 0.191 | -0.047** | (-1.999) |
| Medium | 0.261 | 0.440 | 0.258 | 0.265 | -0.007 | (-0.253) |
| High | 0.569 | 0.495 | 0.598 | 0.544 | 0.054* | (1.727) |
| East dummy | 0.225 | 0.417 | 0.236 | 0.215 | 0.021 | (0.781) |
| ***Controls*** | | | | | | |
| "Big Three" financial literacy count (0-3) | 2.189 | 0.984 | 2.236 | 2.149 | 0.087 | (1.397) |
| "Big Three" correct (0/1) | 0.501 | 0.500 | 0.522 | 0.483 | 0.038 | (1.210) |
| FL1 Interest correct dummy | 0.786 | 0.410 | 0.788 | 0.785 | 0.003 | (0.126) |
| FL2 Inflation correct dummy | 0.778 | 0.416 | 0.806 | 0.756 | 0.050* | (1.920) |
| FL3 Risk diversification correct dummy | 0.624 | 0.485 | 0.642 | 0.608 | 0.033 | (1.091) |
| Conf. to make good fin. decisions bef. exp. (0-10) | 6.301 | 2.061 | 6.498 | 6.136 | 0.362*** | (2.773) |
| Stock ownership (0/1) | 0.448 | 0.498 | 0.504 | 0.401 | 0.104*** | (3.295) |
| Bond ownership (0/1) | 0.186 | 0.389 | 0.216 | 0.160 | 0.056** | (2.262) |
| Risk tolerance (0-10) | 4.702 | 2.531 | 4.631 | 4.761 | -0.130 | (-0.805) |
| Financial risk tolerance (0-10) | 3.926 | 2.715 | 4.094 | 3.785 | 0.309* | (1.789) |
| Observations | 1,002 | | 458 | 544 | 1,002 | |

**Table A7: OLS regression results for confidence – Additional definitions**

This table reports the OLS estimates of the effect of the framing treatment, the advice-giving treatment and several control variables on additional confidence measures. In Panel A, the dependent variables are confidence to participant in the stock market (Columns 1-3), fear of investing (Columns 4-6), and no stock market participation without an advisor (Columns 7-9). In Panel B, the dependent variables are the difference in confidence before and after the experiment (Columns 1-3), a dummy that equals 1 if there was a decrease in confidence, 0 otherwise (Columns 4-6), and a dummy that equals 1 if there was an increase in confidence, 0 otherwise (Columns 7-9). In Columns 1, 4, and 7, the full sample is analyzed. In Columns 2, 5, and 8, the sample is restricted to participants "giving proper advice", i.e., excluding the two answer categories "invalid advice" and "unable to give advice". In Columns 3, 6, and 9, the sample is restricted to those who answer all three comprehension questions correctly. Robust standard errors are shown in parentheses. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

**Panel 1:**

| VARIABLES | (1) | (2) Conf. SMP | (3) | (4) | (5) Fear investing | (6) | (7) | (8) w/o advisor no SMP | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Full sample | Giving proper advice | 3 compreh. questions correct | Full sample | Giving proper advice | 3 compreh. questions correct | Full sample | Giving proper advice | 3 compreh. questions correct |
| Framing treatment: Finance frame | 0.327 | 0.528** | 0.678** | -0.191 | -0.0507 | -0.253 | 0.242 | 0.542 | 0.159 |
| | (0.232) | (0.254) | (0.343) | (0.251) | (0.273) | (0.339) | (0.301) | (0.334) | (0.425) |
| Advice treatment: Giving advice | -0.0171 | 0.166 | 0.174 | -0.0134 | -0.379 | -0.384 | 0.0786 | -0.0519 | -0.347 |
| | (0.231) | (0.258) | (0.338) | (0.256) | (0.276) | (0.337) | (0.307) | (0.342) | (0.426) |
| Female | -1.166*** | -1.321*** | -1.628*** | 0.375 | 0.168 | 0.225 | 0.236 | 0.299 | 0.624 |
| | (0.244) | (0.271) | (0.359) | (0.253) | (0.273) | (0.346) | (0.303) | (0.334) | (0.426) |
| Age (in years) | -0.0260** | -0.0210* | 4.55e-05 | -0.0142 | -0.00266 | -0.0194 | 0.00233 | 0.00348 | -0.0200 |
| | (0.0117) | (0.0127) | (0.0181) | (0.0126) | (0.0135) | (0.0184) | (0.0146) | (0.0158) | (0.0207) |
| Risk tolerance (0-10) | 0.360*** | 0.390*** | 0.330*** | -0.0373 | -0.0541 | -0.104 | -0.0283 | -0.0760 | -0.167 |
| | (0.0534) | (0.0598) | (0.0824) | (0.0600) | (0.0674) | (0.0858) | (0.0673) | (0.0758) | (0.103) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | | | | | | |
| 2,000 to less than 3,500 Euro | 0.220 | -0.0952 | 0.0574 | -0.403 | -0.342 | -0.157 | -0.537 | -0.487 | -0.0161 |
| | (0.347) | (0.380) | (0.521) | (0.360) | (0.400) | (0.525) | (0.421) | (0.488) | (0.676) |
| 3,500 to less than 5,000 Euro | 0.922*** | 0.670* | 0.675 | -0.745** | -0.681* | -0.446 | -0.422 | 0.0418 | 0.136 |
| | (0.353) | (0.391) | (0.534) | (0.377) | (0.399) | (0.575) | (0.451) | (0.493) | (0.690) |

**Table A7, Panel 1 (continued)**

| VARIABLES | (1) | (2) Conf. SMP | (3) | (4) | (5) Fear investing | (6) | (7) | (8) w/o advisor no SMP | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Full sample | Giving proper advice | 3 compreh. questions correct | Full sample | Giving proper advice | 3 compreh. questions correct | Full sample | Giving proper advice | 3 compreh. questions correct |
| 5,000 Euro and more | 1.018*** | 0.711* | 1.249** | -1.325*** | -1.269*** | -1.679** | -0.450 | -0.0480 | -0.207 |
| | (0.386) | (0.409) | (0.606) | (0.416) | (0.434) | (0.658) | (0.491) | (0.527) | (0.766) |
| Not specified | -0.384 | -0.376 | 0.383 | -0.0899 | 0.375 | 0.0339 | -1.123* | -0.642 | 0.0698 |
| | (0.421) | (0.472) | (0.668) | (0.482) | (0.520) | (0.560) | (0.594) | (0.646) | (0.797) |
| *Reference category: Low education level* | | | | | | | | | |
| Medium education level | 0.366 | 0.377 | 0.383 | 0.343 | -0.170 | -0.0695 | 0.121 | -0.132 | 0.178 |
| | (0.367) | (0.424) | (0.635) | (0.429) | (0.483) | (0.777) | (0.511) | (0.600) | (0.937) |
| High education level | 0.825** | 0.885** | 0.512 | 0.255 | 0.0673 | -0.215 | -0.172 | -0.355 | -0.131 |
| | (0.354) | (0.399) | (0.581) | (0.409) | (0.447) | (0.714) | (0.490) | (0.551) | (0.835) |
| Conf. to make good fin. decisions bef. exp. (0-10) | 0.418*** | 0.383*** | 0.348*** | -0.188*** | -0.210*** | -0.406*** | -0.0685 | -0.137 | -0.347*** |
| | (0.0635) | (0.0719) | (0.0873) | (0.0721) | (0.0786) | (0.0927) | (0.0836) | (0.0936) | (0.115) |
| “Big Three” correct | 1.338*** | 1.543*** | 1.568*** | -0.547** | -0.163 | -0.277 | -1.302*** | -1.630*** | -1.293*** |
| | (0.253) | (0.276) | (0.398) | (0.275) | (0.307) | (0.389) | (0.324) | (0.364) | (0.486) |
| East dummy | -0.501* | -0.724** | -0.196 | 0.410 | 0.252 | 0.234 | 0.101 | -0.0339 | 0.0597 |
| | (0.290) | (0.324) | (0.423) | (0.309) | (0.342) | (0.459) | (0.365) | (0.418) | (0.490) |
| Constant | 0.205 | 0.178 | 0.235 | 8.508*** | 8.392*** | 10.81*** | 7.603*** | 8.277*** | 10.30*** |
| | (0.673) | (0.745) | (1.010) | (0.834) | (0.911) | (1.058) | (1.013) | (1.111) | (1.287) |
| Observations | 543 | 443 | 242 | 543 | 443 | 242 | 543 | 443 | 242 |
| R-squared | 0.376 | 0.389 | 0.381 | 0.080 | 0.076 | 0.206 | 0.056 | 0.081 | 0.149 |

**Table A7, Panel 2: OLS regression results for confidence – Additional definitions**

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Difference in confidence | | | Dummy for decrease in confidence | | | Dummy for increase in confidence | | |
| | Full sample | Giving proper advice | 3 compreh. questions correct | Full sample | Giving proper advice | 3 compreh. questions correct | Full sample | Giving proper advice | 3 compreh. questions correct |
| Framing treatment: Finance frame | 0.0307 | 0.160 | 0.0983 | 0.00489 | -0.0284 | 0.0172 | -0.0138 | 0.00431 | 0.0123 |
| | (0.152) | (0.155) | (0.173) | (0.0398) | (0.0434) | (0.0522) | (0.0387) | (0.0433) | (0.0619) |
| Advice treatment: Giving advice | 0.0822 | 0.306* | 0.176 | -0.0131 | -0.0387 | -0.0194 | -0.0409 | 0.00324 | -0.00511 |
| | (0.153) | (0.164) | (0.176) | (0.0406) | (0.0451) | (0.0534) | (0.0392) | (0.0454) | (0.0628) |
| Female | -0.412** | -0.398** | -0.345* | 0.0502 | 0.0446 | 0.0517 | -0.0793** | -0.0708 | -0.0600 |
| | (0.161) | (0.170) | (0.184) | (0.0417) | (0.0466) | (0.0570) | (0.0398) | (0.0450) | (0.0637) |
| Age (in years) | -0.0111 | -0.00960 | 0.00996 | 0.00234 | 0.00186 | -0.00451 | -0.00220 | -0.00161 | 0.00297 |
| | (0.00764) | (0.00791) | (0.00929) | (0.00205) | (0.00232) | (0.00277) | (0.00204) | (0.00237) | (0.00329) |
| Risk tolerance (0-10) | 0.0452 | 0.0180 | 0.0886** | -0.00883 | -0.00172 | -0.0192 | 0.0129 | 0.0112 | 0.0352** |
| | (0.0335) | (0.0344) | (0.0383) | (0.00881) | (0.00970) | (0.0126) | (0.00835) | (0.00957) | (0.0146) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | | | | | | |
| 2,000 to less than 3,500 Euro | 0.271 | 0.247 | 0.138 | -0.0880 | -0.0285 | 0.0358 | 0.0750 | 0.0642 | 0.0613 |
| | (0.242) | (0.262) | (0.282) | (0.0592) | (0.0669) | (0.0917) | (0.0569) | (0.0664) | (0.106) |
| 3,500 to less than 5,000 Euro | 0.552** | 0.512** | 0.276 | -0.177*** | -0.134** | -0.0441 | 0.106* | 0.0935 | 0.117 |
| | (0.252) | (0.256) | (0.296) | (0.0608) | (0.0662) | (0.0899) | (0.0605) | (0.0695) | (0.106) |
| 5,000 Euro and more | 0.225 | 0.198 | 0.0296 | -0.0699 | -0.00966 | 0.0616 | 0.0333 | 0.0252 | -0.00756 |
| | (0.264) | (0.270) | (0.309) | (0.0658) | (0.0713) | (0.101) | (0.0638) | (0.0698) | (0.115) |
| Not specified | 0.0863 | -0.0985 | 0.241 | -0.0625 | 0.0168 | -0.0765 | -0.148** | -0.235*** | -0.135 |
| | (0.291) | (0.289) | (0.369) | (0.0825) | (0.0928) | (0.116) | (0.0656) | (0.0714) | (0.122) |
| *Reference category: Low education level* | | | | | | | | | |
| Medium education level | 0.717*** | 0.869*** | 0.0725 | -0.0722 | -0.150** | 0.0288 | 0.163*** | 0.220*** | 0.0564 |
| | (0.268) | (0.285) | (0.346) | (0.0627) | (0.0725) | (0.100) | (0.0576) | (0.0691) | (0.127) |
| High education level | 0.643** | 0.709** | -0.109 | -0.0228 | -0.0720 | 0.0400 | 0.0939 | 0.121* | -0.0291 |
| | (0.264) | (0.284) | (0.312) | (0.0629) | (0.0718) | (0.0941) | (0.0594) | (0.0695) | (0.116) |

**Table A7, Panel 2 (continued)**

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Difference in confidence | | | Dummy for decrease in confidence | | | Dummy for increase in confidence | | |
| | Full sample | Giving proper advice | 3 compreh. questions correct | Full sample | Giving proper advice | 3 compreh. questions correct | Full sample | Giving proper advice | 3 compreh. questions correct |
| Conf. to make good fin. decisions bef. exp. (0-10) | -0.251*** | -0.253*** | -0.216*** | 0.0175* | 0.0145 | 0.0142 | -0.0479*** | -0.0580*** | -0.0779*** |
| | (0.0455) | (0.0501) | (0.0473) | (0.0102) | (0.0112) | (0.0144) | (0.00950) | (0.0108) | (0.0148) |
| "Big Three" correct | 0.295* | 0.0622 | 0.101 | -0.0875** | -0.0715 | -0.113* | 0.0699 | 0.0356 | 0.0843 |
| | (0.173) | (0.184) | (0.210) | (0.0440) | (0.0498) | (0.0658) | (0.0428) | (0.0489) | (0.0727) |
| East dummy | -0.0552 | 0.0764 | 0.168 | 0.0192 | -0.0114 | -0.0123 | -0.0127 | -0.0171 | 0.0364 |
| | (0.188) | (0.196) | (0.246) | (0.0486) | (0.0527) | (0.0690) | (0.0459) | (0.0534) | (0.0830) |
| Constant | 1.090** | 1.185** | 0.996 | 0.277** | 0.296** | 0.374** | 0.561*** | 0.614*** | 0.614*** |
| | (0.486) | (0.553) | (0.614) | (0.126) | (0.145) | (0.182) | (0.125) | (0.144) | (0.207) |
| Observations | 543 | 443 | 242 | 543 | 443 | 242 | 543 | 443 | 242 |
| R-squared | 0.126 | 0.139 | 0.140 | 0.043 | 0.047 | 0.053 | 0.087 | 0.102 | 0.140 |

**Table A8: OLS regression results for confidence – Additional specification**

This table reports the OLS estimates of the effect of the framing treatment, the advice-giving treatment, the interaction of the two treatments, and several control variables on confidence. The dependent variables are confidence after the experiment (Columns 1 and 2) and a dummy measuring the number of "do not know" responses to the financial literacy questions after the experiment (Columns 3 and 4). Robust standard errors are shown in parentheses. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | Confidence after the experiment (0-10) | | # DNK after (0-3) | |
| Framing treatment: Finance frame | 0.614** | 0.243 | -0.0751 | -0.0394 |
| | (0.294) | (0.208) | (0.0884) | (0.0835) |
| Advice treatment: Giving advice | 0.308 | 0.290 | 0.0692 | 0.0904 |
| | (0.296) | (0.210) | (0.0962) | (0.0878) |
| Finance frame x Giving Advice | -0.833** | -0.422 | 0.0867 | 0.0223 |
| | (0.412) | (0.306) | (0.136) | (0.124) |
| Female | | -0.413** | | 0.0883 |
| | | (0.161) | | (0.0637) |
| Age (in years) | | -0.0114 | | -0.000130 |
| | | (0.00770) | | (0.00339) |
| Risk tolerance (0-10) | | 0.0412 | | -0.00508 |
| | | (0.0338) | | (0.0124) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | |
| 2,000 to less than 3,500 Euro | | 0.252 | | 0.275*** |
| | | (0.242) | | (0.103) |
| 3,500 to less than 5,000 Euro | | 0.557** | | 0.127 |
| | | (0.253) | | (0.102) |
| 5,000 Euro and more | | 0.229 | | 0.156 |
| | | (0.263) | | (0.105) |
| Not specified | | 0.0764 | | 0.713*** |
| | | (0.289) | | (0.167) |
| *Reference category: Low education level* | | | | |
| Medium education level | | 0.689** | | -0.147 |
| | | (0.270) | | (0.108) |
| High education level | | 0.626** | | -0.269*** |
| | | (0.262) | | (0.102) |
| Conf. to make good fin. decisions bef. exp. (0-10) | | 0.749*** | | -0.0686*** |
| | | (0.0457) | | (0.0171) |
| "Big Three" correct | | 0.281 | | -0.395*** |
| | | (0.173) | | (0.0681) |
| East dummy | | -0.0616 | | 0.0207 |
| | | (0.188) | | (0.0742) |
| Constant | 6.782*** | 1.050** | 0.408*** | 1.064*** |
| | (0.216) | (0.487) | (0.0633) | (0.205) |
| Observations | 544 | 543 | 544 | 543 |
| R-squared | 0.009 | 0.491 | 0.006 | 0.201 |

**Table A9: OLS regression results for motivation – Additional specification**

This table reports the OLS estimates of the effect of the framing treatment, the advice-giving treatment, the interaction of the two treatments and several control variables on motivation. In Columns 1-3, the dependent variable is direct motivation (0-10). In Columns 4-6, the dependent variable is indirect motivation, measured as a dummy that equals 1 if the participant downloaded a document, 0 otherwise. Moreover, it shows whether the overall interaction effect, i.e., $\beta_1 + \beta_2 + \beta_3$, is statistically significantly different from zero. Robust standard errors are shown in parentheses. Significance levels are indicated as *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| VARIABLES | Motivation (direct, 0-10) | | | Motivation (indirect, download 0/1) | | |
| Framing treatment: Finance frame | 0.525 | 0.248 | 0.116 | -0.103* | -0.116** | -0.119** |
| | (0.344) | (0.305) | (0.276) | (0.0606) | (0.0562) | (0.0561) |
| Advice treatment: Giving advice | 0.142 | 0.164 | 0.0430 | -0.118** | -0.103* | -0.101* |
| | (0.353) | (0.321) | (0.296) | (0.0598) | (0.0584) | (0.0589) |
| Finance frame x Giving Advice | -0.672 | -0.237 | -0.0233 | 0.00889 | 0.0393 | 0.0429 |
| | (0.491) | (0.438) | (0.405) | (0.0838) | (0.0808) | (0.0807) |
| Female | | -0.185 | 0.0708 | | 0.0224 | 0.0335 |
| | | (0.225) | (0.202) | | (0.0415) | (0.0418) |
| Age (in years) | | -0.0444*** | -0.0396*** | | -0.00431** | -0.00437** |
| | | (0.0110) | (0.0106) | | (0.00205) | (0.00205) |
| Risk tolerance (0-10) | | 0.146*** | 0.131*** | | 0.0232*** | 0.0238*** |
| | | (0.0525) | (0.0484) | | (0.00885) | (0.00890) |
| *Reference category: HH disposable income less than 2,000 Euro* | | | | | | |
| 2,000 to less than 3,500 Euro | | 0.385 | 0.250 | | -0.00617 | -0.00950 |
| | | (0.344) | (0.315) | | (0.0587) | (0.0586) |
| 3,500 to less than 5,000 Euro | | 0.560* | 0.208 | | 0.112* | 0.0957 |
| | | (0.337) | (0.319) | | (0.0627) | (0.0633) |
| 5,000 Euro and more | | 0.816** | 0.643* | | 0.0700 | 0.0588 |
| | | (0.375) | (0.357) | | (0.0673) | (0.0677) |
| Not specified | | -0.278 | -0.265 | | -0.163** | -0.155** |
| | | (0.395) | (0.401) | | (0.0726) | (0.0718) |

**Table A9 (continued)**

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Motivation (direct, 0-10) | | | Motivation (indirect, download 0/1) | | |
| *Reference category: Low education level* | | | | | | |
| Medium education level | | 0.562 | 0.0924 | | 0.0822 | 0.0566 |
| | | (0.369) | (0.319) | | (0.0578) | (0.0583) |
| High education level | | 0.490 | 0.0201 | | 0.209*** | 0.179*** |
| | | (0.345) | (0.307) | | (0.0609) | (0.0624) |
| East dummy | | -0.0407 | -0.00318 | | -0.0492 | -0.0476 |
| | | (0.249) | (0.217) | | (0.0464) | (0.0463) |
| Conf. to make good fin. decisions bef. exp. (0-10) | | 0.483*** | 0.0402 | | 0.00631 | -0.0103 |
| | | (0.0646) | (0.0881) | | (0.0100) | (0.0127) |
| Conf. to make good fin. decisions after exp. (0-10) | | | 0.576*** | | | 0.0197* |
| | | | (0.0752) | | | (0.0108) |
| "Big Three" correct | | 0.686*** | 0.395* | | 0.0761* | 0.0494 |
| | | (0.235) | (0.238) | | (0.0439) | (0.0471) |
| FL score (0-3, after) | | | 0.190 | | | 0.0314 |
| | | | (0.119) | | | (0.0240) |
| Constant | 6.746*** | 3.139*** | 2.418*** | 0.521*** | 0.298** | 0.258** |
| | (0.247) | (0.678) | (0.600) | (0.0421) | (0.123) | (0.126) |
| Observations | 544 | 543 | 543 | 544 | 543 | 543 |
| R-squared | 0.006 | 0.263 | 0.387 | 0.024 | 0.140 | 0.148 |
| The interaction effect: $\beta_1 + \beta_2 + \beta_3 = 0$ | -0.005 | 0.175 | 0.136 | -0.21211 | -0.1797 | -0.1771 |
| | F(1, 540) = 0.00 | F(1, 527) = 0.30 | F(1, 525) = 0.23 | F(1, 540) = 13.51 | F(1, 527) = 10.09 | F(1, 525) = 9.84 |
| | Prob > F = 0.9874 | Prob > F = 0.5813 | Prob > F = 0.6343 | Prob > F = 0.0003 | Prob > F = 0.0016 | Prob > F = 0.0018 |

## Appendix D: List of variables

Appendix D summarizes all variables used throughout the analyses. It contains the variable name, the original question, and the definition.

| Variable name | Original question | Definition |
|---|---|---|
| # DNK after (0-3) | Number of "do not know" answers to FL4-FL6 | Score 0-3 |
| Advice task 1 (closed) | Would you recommend investing in the capital market to a friend? | 0 "Not recommend at all"<br>10 "Highly recommend" |
| Advice task 2 (closed) | Please think of a friend who is just starting out in working life.<br>Would you advise him or her to start saving for old age straight away? | 0 "Not recommend at all"<br>10 "Highly recommend" |
| Advice task 3 (closed) | Please think of a friend who has no experience with pensions and finances.<br>Would you recommend that a friend to seek professional advice on pensions and finances? | 0 "Not recommend at all"<br>10 "Highly recommend" |
| Advice-giving task (open field) | What tips would you give to a friend when it comes to saving for retirement? Please describe your advice in a few short sentences or bullet points. | Open field<br>→ Manual coding in 15 categories |
| Advice-giving treatment | | 0 = No advice-giving<br>1 = Advice-giving task |
| Age (in years) | Age derived from "Year of birth" | Ages between 18-55 years |
| At least one of FL4 and FL6 correct | | Dummy =1 if at least one of FL4 and FL6 correct, 0 otherwise |
| "Big Three" correct (dummy) | | 0 = "Big Three" not correct<br>1 = "Big Three" correct |
| "Big Three" financial literacy count (0-3) | | Score 0-3 |
| Bond ownership (0/1) | We will now ask you a question about financial assets: Did you (i.e., your household) own any of the following types of assets in December 2023? | 0 = No<br>1 = Yes |
| Both FL4 and FL6 correct | | Dummy =1 if both FL4 and FL6 correct, 0 otherwise |
| Comprehension question Q1 | To help you familiarize yourself with the graph, we present three scenarios.<br>In the first scenario, we ask you to read a value in the graph. You do not have to adjust any of the values.<br>Scenario 1:<br>*[Neutral frame]* Mrs. Blau wants to plant 100 trees every year over the duration of the project. She selects a 50% share of tree species 2.<br>What is her predicted yield in the best 5 out of 100 cases?<br>*[Finance frame]* Mrs. Blau would like to invest a monthly savings amount of 100 Euro over a period of 20 years. She chooses an equity share of 50%.<br>How high are her projected assets in the best 5 out of 100 cases? | _____ Euro |
| Comprehension question Q1 correct | | 1= Correct answer to comprehension question 1<br>0 = otherwise |

| Variable name | Original question | Definition |
|---|---|---|
| Comprehension question Q2 | *[Neutral frame]* In scenario 2, we ask you to adjust the share of tree species 2 and then read off the average yield from the graph.<br>Scenario 2: Mr. Lila can plant 100 trees every year. He selects a 70% share of tree species 2.<br>What is his predicted average yield at the end of the project?<br>*[Finance frame]* In scenario 2, we ask you to adjust the share of the risky asset and then read off the average assets from the graph.<br>Scenario 2: Mr. Lila can set aside 100 Euro per month. He selects an equity share of 70%.<br>What is his projected average wealth after 20 years? | _____ Euro |
| Comprehension question Q2 correct | | 1= Correct answer to comprehension question 2<br>0 = otherwise |
| Comprehension question Q3 | *[Neutral frame]* In scenario 3, we ask you to adjust the number of trees. Please pay attention to the changes in the graph.<br>Scenario 3: Mrs. Gelb is willing to plant 50% of tree species 2 in her forest. During the project, she would like to achieve a yield of 30,500 Euro in the worst 5 out of 100 cases.<br>How many trees must she plant each year in order to achieve this in the worst 5 out of 100 cases?<br>*[Finance frame]* In scenario 3, we ask you to adjust the monthly savings amount. Please pay attention to the changes in the graph.<br>Scenario 3: Mrs. Gelb is prepared to accept a 50% share of equities in her portfolio. She would like to build up assets of 43,500 Euro in 20 years in the worst 5 out of 100 cases.<br>How much money must she save each month in order to achieve this in the worst 5 out of 100 cases? | *[Neutral frame]* _____ trees<br><br>*[Finance frame]* _____ Euro |
| Comprehension question Q3 correct | | 1= Correct answer to comprehension question 3<br>0 = otherwise |
| Comprehension question score | | Number of correct answers to comprehension questions (score 0-3) |
| Conf. SMP | I have the confidence to participate in the stock market. | 0 “fully disagree” to 10 “fully agree” |
| Conf. to make good fin. decisions bef. exp. | How much confidence do you have in your ability to make good financial decisions? | 0 “no confidence” to 10 “very high confidence” |
| Confidence after the experiment | How much confidence do you have in your ability to make good financial decisions? | 0 “no confidence” to 10 “very high confidence” |
| Confidence comprehension questions 1-3 | How confident are you that your answer [to comprehension questions Q1-Q3] is correct? | 0 “no confidence” to 10 “very high confidence” |
| Confidence comprehension questions 1-3 (Dummy) | | Not sure (0-3)<br>Neutral (4-6)<br>Very sure (7-10) |
| Difference in confidence before and after the experiment | | |

| Variable name | Original question | Definition |
|---|---|---|
| Dummy for decrease in confidence | | 0 = No<br>1 = Yes |
| Dummy for increase in confidence | | 0 = No<br>1 = Yes |
| East (dummy) | Where do you currently live? | 0 = Former West Germany<br>1 = Former East Germany<br>[Derived from Bundesland] |
| Education | What is your highest level of education? | 0 = Kein allgemeiner Schulabschluss<br>1= Haupt-/ Volksschule ohne abgeschlossene Lehre<br>2 = Haupt-/ Volksschule mit abgeschlossener Lehre<br>3 = Mittel-, Real-, Höhere-, Fach-, Handelsschule ohne Abitur<br>4 = Abitur/ Hochschulreife<br>5 = Abgeschlossenes Studium |
| Education dummy | | 0 = low level of education, i.e., education = 0-2<br>1 = medium level of education, i.e., education = 3<br>2 = high level of education, i.e., education = 4-5 |
| Fatigue | | Minutes the participants tool to complete the survey |
| Fear investing | I am afraid of investing money or making financial decisions. | 0 “fully disagree” to 10 “fully agree” |
| Feedback: Complexity | The graphical representation in the interactive graph is complicated. | 0 = “does not apply at all”<br>10 = “fully applies” |
| Feedback: Comprehensibility | To what extent do you agree with the following statements:<br>The graphical representation in the interactive graph is understandable. | Please rate on a scale from 0 to 10. 0 means “does not apply at all” and 10 means “fully applies”. |
| Feedback: Helpfulness | The graphical representation in the interactive graph is helpful. | 0 = “does not apply at all”<br>10 = “fully applies” |
| Feedback: Informativeness | I feel well informed by the scenarios shown in the interactive graph. | 0 = “does not apply at all”<br>10 = “fully applies” |
| Female | Are you… | 0 = Male<br>1 = Female |
| Final decision in finance frame – Savings amount | Please think about your own financial situation. Which values would you choose for yourself in the interactive graph? | Monthly savings amount in Euro |
| Final decision in finance frame – Share of risky asset | Please think about your own financial situation. Which values would you choose for yourself in the interactive graph? | Share of risky assets in the portfolio (0-100) |
| Financial literacy score (0-6) | Sum of six financial literacy questions | 0 - 6 number of correct answers |
| Financial risk tolerance (0-10) | Please assess your willingness to take a financial risk. | Scale of 0 to 10<br>0 = Not at all willing to take risks<br>10 = Very willing to take risks |
| FL score (0-3, after) | | 0 - 3 number of correct answers |

| Variable name | Original question | Definition |
|---|---|---|
| FL1 Interest | Suppose you have a deposit of 100€ in your savings account. The interest rate is 2% per year and you keep it on this account for 5 years. What do you think: How much money will be on your savings account after 5 years? | **1 = More than 110 Euro**<br>2 = Exactly 110 Euro<br>3 = Less than 110 Euro<br>4 = Do not know<br>5 = Refuse to answer |
| FL2 Inflation | Suppose the interest on your savings account is 1% per year and the inflation rate is 2% per year. What do you think: Will you be able to buy more, less or the same amount of goods with the deposited money after one year? | 1 = More<br>2 = Just as much<br>**3 = Less than today**<br>4 = Do not know<br>5 = Refuse to answer |
| FL3 Risk diversification | Is the following statement right or wrong: "Investing in shares of a single company bears fewer risks than investing in a fund?" | 1 = Agree<br>**2 = Do not agree**<br>3 = Do not know<br>4 = Refuse to answer |
| FL4 Purpose of stock market | What is the main function of the stock market? | 1 = The stock market helps to predict share profits<br>2 = The stock market leads to an increase in share prices<br>**3 = The stock market brings buyers and sellers of shares together**<br>4 = None of these<br>5 = Do not know<br>6 = Refuse to answer |
| FL5 Volatility of returns | Which of the following investment forms has the highest volatility of returns? | 1 = Savings accounts<br>2 = Fixed-term deposits<br>3 = Fixed-interest securities<br>**4 = Shares**<br>5 = Do not know<br>6 = Refuse to answer |
| FL6 Comprehending risk | There's a 50/50 chance that Malik's car will need engine repairs within the next six months which would cost 1,000 Euro. At the same time there is a 10% chance that he will need to replace the air conditioning unit in his house, which would cost 4,000 Euro. Which poses the greater financial risk for Malik? | **1 = The car repair**<br>2 = The air conditioning replacement<br>3 = There is no way to tell in advance<br>4 = Do not know<br>5 = Refuse to answer |
| Framing treatment | | 0 = Neutral frame<br>1 = Finance frame |
| Household monthly disposable income | How much do you estimate is the MONTHLY disposable net income of your household, i.e., the money that is available to the entire household after deduction of taxes and social security contributions to cover expenses?<br>Please take into account the types of income listed in your answer.<br><br>Wage<br>Salary<br>Income from self-employment<br>Annuity or pensions<br>Public Aid Income<br>Rental income<br>Lease income<br>Housing benefit<br>Child benefit<br>Other Income | 1 = Less than 500 Euro<br>2 = 500 to less than 750 Euro<br>3 = 750 to less than 1,000 Euro<br>4 = 1,000 to less than 1,250 Euro<br>5 = 1,250 to less than 1,500 Euro<br>6 = 1,500 to less than 2,000 Euro<br>7 = 2,000 to less than 2,500 Euro<br>8 = 2,500 to less than 3,000 Euro<br>9 = 3,000 to less than 3,500 Euro<br>10 = 3,500 to less than 4,000 Euro<br>11 = 4,000 to less than 4,500 Euro<br>12 = 4,500 to less than 5,000 Euro<br>13 = 5,000 to less than 7,500 Euro<br>14 = 7,500 to less than 10,000 Euro<br>15 = 10,000 to less than 15,000 Euro<br>16 = 15,000 Euro and more |

| Variable name | Original question | Definition |
|---|---|---|
| Household monthly disposable income (dummy) | | 1 = Less than 2,000 Euro<br>2 = 2,000 to less than 3,500 Euro<br>3 = 3,500 to less than 5,000 Euro<br>4 = 5,000 Euro and more<br>5 = Not specified |
| Household size | Number of household members | Numeric values |
| Marital Status | What is your marital status? | 1 = Single without a partner in the household<br>2 = Single with a partner in the household<br>3 = married and living together<br>4 = Divorced / separated / widowed without a partner in the house<br>5 = Divorced / separated / widowed with a partner in the house |
| Motivation (direct, 0-10) | How motivated are you to [further] deal with the topic of "saving and investing"? | 0 "Not motivated at all" to 10 "Very strongly motivated" |
| Motivation (indirect) | "Thank you for taking part in our survey! As a thank you, we offer you the opportunity to download one of these three resources free of charge." | 0 = No, thank you<br>1 = E-book on investing<br>2 = ZEW expert brief on COVID-crisis<br>3 = Link to consumer advice center |
| Motivation (indirect, download 0/1) | Download additional material | 0 = No download<br>1 = Downloaded additional material |
| Risk tolerance (0-10) | How do you rate yourself personally: Are you generally a risk-taking person or do you do you try to avoid risks? | Scale of 0 to 10<br>0 = Not at all willing to take risks<br>10 = Very willing to take risks |
| Risk tolerance (dummy) | | 1 = Risk averse (0-3)<br>2 = Risk neutral (4-6)<br>3 = Risk seeking (7-10) |
| Self-assessed FL (0-6) | In the course of the survey, we asked you six quiz questions on financial knowledge.<br>How many questions do you think you answered correctly? | 0= None<br>1 = 1<br>2 = 2<br>3 = 3<br>4 = 4<br>5 = 5<br>6 = 6<br>7 = Do not know<br>8 = Refuse to answer |
| Stock ownership (0/1) | We will now ask you a question about financial assets: Did you (i.e., your household) own any of the following types of assets in December 2023? | 0 = No<br>1 = Yes |
| Treatment dummy (2x2) | | 0 = Neutral frame – No Advice<br>1 = Neutral frame – Advice<br>2 = Finance frame – No Advice<br>3 = Finance frame – Advice |
| w/o advisor no SMP | I would never participate in the stock market without my advisor. | 0 "fully disagree" to 10 "fully agree" |

## Appendix E: Sample selection and randomization

*Dropout rates*

Since the survey in general and the simulation tool in particular might be more challenging for some subgroups of the population than for others, there might be systematic dropouts throughout the survey. Figure A1, Panel A in Appendix C shows the absolute number of participants that reached a specific page during the online survey. In total, 807 individuals entered the survey. The number of participants slightly decrease throughout the first part of the questionnaire and the introduction of the simulation tool. The biggest dropout point is the first comprehension question: the number of participants drops by 8% from 688 to 630. This seems to be the most challenging part of the entire survey. On the one hand, participants – especially experienced clickers – might not be willing to exercise the necessary mental effort to answer this question and might not be motivated enough to continue. On the other hand, participants might be overwhelmed with the complexity of the tool. Once, the participants complete the comprehension questions, they most likely finish the questionnaire. Overall, 588 participants reached the final page of the questionnaire.

To analyze systematic dropouts, Figure A1, Panel B in Appendix C shows the dropout rates by framing treatment and by gender in percent. When transitioning from the last slide of the slide show to the first comprehension question, one observes a steeper slope in the drop-out rate in both the finance frame and the neutral frame. This shows once again that the drop-out rate is particularly high at this point in the survey. An additional multivariate analysis (results not shown) confirms that participants in the finance frame are equally likely to complete the survey compared to those in the neutral frame. However, women are more likely to drop out of the survey than men. Interestingly, only women in the neutral frame are statistically significantly more likely to drop out compared to men in the neutral frame. The gender difference in dropout rates in the finance frame is smaller and not significantly different from zero (results not shown).

*Data cleaning*

I clean the data set in three steps. First, I exclude the N=219 participants (27.1% of the total sample) who did not finish the questionnaire. Second, participants with answer times below 6 minutes (so-called speeders) are excluded to ensure the informativeness of the answers (N=39). Finally, I exclude participants who answered the survey in under 10 minutes and always gave the same answer to the three comprehension questions (N=5).[50] Thus, the final sample size is N=544.

[50] While well-trained clickers might simply be faster than less-trained participants, checking the comprehension questions ensures that they took the simulation tool seriously.

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