The Influence of Uncertain Environmental Impact on Risk Taking in Asset Allocation *

Oliver Frensch[1], Olaf Korn[1,2], and Holger A. Rau[1,3]

[1]University of Göttingen

[2]Centre for Financial Research (CFR) Cologne

[3]University of Duisburg-Essen

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Abstract

This experimental study investigates how environmental impact uncertainty influences asset allocation decisions. Our pre-registered online experiment controls the environmental impact risk of an investment by linking investment decisions to the retiring of CO_2 emission certificates. Most participants adjust their investment strategies when confronted with impact risk, especially when such risks affect financially safe assets. Highly risk-averse investors show the strongest reduction of investments in impact-risky assets. We provide causal evidence that such modifications in investment behavior stem from changes in risk perceptions. These findings suggest the need for enhanced risk assessment frameworks that integrate environmental impact uncertainty in financial decision-making.

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Keywords: Asset Allocation, Impact Uncertainty, Risk Taking, Sustainable Assets

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1 Introduction

In recent years, sustainable investments have established themselves as an important investment vehicle, reaching $6.5 trillion in the US by 2024 (SIF, 2024) and representing 38% of total assets under management in the EU (EPRS, 2024). Beyond the importance of sustainability for institutional investors (Dyck et al., 2019; Krueger et al., 2020), there is evidence that demand also stems from retail investors, who are driven by both financial motives and non-financial sustainability preferences (Hartzmark and Sussman, 2019; Giglio et al., 2025). These non-financial preferences can be two-dimensional. Investors may try to signal their concern for sustainability by aligning their portfolios with sustainable assets, which can be motivated by social image concerns (Bénabou and Tirole, 2006; Friedrichsen and Engelmann, 2018). Moreover, intrinsic social preferences may explain why investors engage in socially responsible investments (SRI) even without external recognition (Riedl and Smeets, 2017). Consequently, a growing literature examines how preferences for sustainable investments translate into investors' willingness to pay (WTP) for sustainable investment products (e.g., Gutsche and Ziegler, 2019; Barber et al., 2021; Heeb et al., 2023). The findings highlight that investors have a considerable WTP for sustainable assets.

Despite these intriguing insights, existing studies have predominantly overlooked two critical dimensions: the portfolio context of investment decisions and the uncertainty surrounding actual sustainability impact—a phenomenon we term "impact risk."[1] This concept addresses whether sustainable investments will yield their intended effects. Impact risk could fundamentally alter financial risk-taking behavior, as investors' perception of impact risk might interact with purely financial risk considerations, consistent with behavioral economics findings showing that risk preferences can be context-dependent and influenced by external factors such as reference points (Kahneman and Tversky, 1979), framing effects (Tversky and Kahneman, 1981), or social comparisons (Müller and Rau, 2019; Schwerter, 2024). A deeper understanding of how impact risk influences financial risk-taking has important practical implications for issuers of sustainable securities, disclosure regulations, financial advisors, and fund managers responsible for client portfolios.

With our study, we address these two critical research gaps: the portfolio context of sus-

[1] Impact risk is a realistic feature also observed in other domains, such as charitable giving (Brock et al., 2013; Gneezy et al., 2014), or public-good provision (Gangadharan and Nemes, 2009).

tainable investments and the uncertainty about their impact. We investigate investors' portfolio decisions in a setting where they decide on allocating funds into two sustainable assets, a financially risky one and a risk-free one, while explicitly incorporating the dimension of impact risk. Our primary objective is to examine how the introduction of impact risk for one of the assets alters investors' portfolio allocations and financial risk-taking decisions. In contrast to the existing literature, which often relies on framed field experiments (e.g., Heeb et al., 2023) for measuring the WTPs of real products, we employ an online experiment. In our setting, participants engage in portfolio decision-making involving artificial assets, similar to the investment task of Gneezy and Potters (1997). There are two reasons for this approach that provides a very high degree of internal validity. First, in our analysis of the role of impact risk, it is crucial to have precise control over whether the environmental impact occurs or not. Our experimental setup allows us to design scenarios where we can credibly have control over the environmental impact of the sustainable assets. Should an environmental impact occur, we will implement it by withdrawing CO_2 certificates from the market. Second, our within-subjects design, in which participants make decisions both before and after the introduction of impact risk, enables us to causally identify the effect of impact risk on investors' financial risk-taking.

Our design also enables us to examine how participants' pre-existing differences in financial risk appetite shape their responses to impact risk. Specifically, we investigate via between-subjects comparisons how the interplay between an asset's financial risk and its impact risk affects investors' risk-taking behavior. We focus on two treatments that vary how impact risk emerges across our two assets. In the *Consistent Risks* treatment, impact risk aligns with financial risk, affecting only the financially risky asset in the second stage of the experiment. In this treatment, impact risk should predominantly affect participants with lower financial risk aversion, particularly those who initially allocated substantial portions of their portfolios to the financially risky asset in the first stage. Conversely, in the *Conflicting Risks* treatment, impact risk misaligns with financial risk, affecting the financially risk-free asset instead. This arrangement predominantly affects more risk-averse investors who initially allocated higher proportions of their portfolios to the financially risk-free asset. We analyze changes in financial risk taking under these two treatments, relating to the risk aversion of participants, and compare treatment effects to determine whether reactions are more pronounced when impact and financial risks conflict. This analysis of diverse participant responses under both treatments is essential

for understanding how risk preferences with regard to financial risk and impact risk interact in portfolio decisions. Finally, we exploit the advantages of experiments to gather comprehensive data on participants' economic preferences, psychological measures, and decision-making motivations, which may shed light on the underlying behavioral channels.

Our results confirm that introducing impact risk prompts a strong reaction, reducing investments in affected assets by 4.53 percentage points on average. This effect is stronger in the *Conflicting Risks* treatment (6.42 percentage points) compared to the *Consistent Risks* treatment (2.39 percentage points), supporting our conjecture that misaligned risks provoke stronger responses. Participants' self-reported risk perceptions confirm they view impact-risky assets as riskier despite identical financial characteristics. When controlling for this subjective risk assessment in our regression analyses, the main effect becomes insignificant.

Our study contributes to three strands of literature. First, we enhance understanding of prosocial preferences in sustainable investments (Gutsche and Ziegler, 2019; Barber et al., 2021; Heeb et al., 2023). Second, we contribute to research on behavioral factors affecting financial risk-taking (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992; Müller and Rau, 2019). Third, we extend knowledge on impact uncertainty's influence on prosocial behavior (Brock et al., 2013; Gneezy et al., 2014). Our findings also have important practical implications. For policymakers, they highlight the need for transparent disclosure frameworks that address both financial and impact risks in sustainable investments. For investment firms, our results stress that clearly communicating impact risk could be as important as traditional financial metrics when marketing sustainable products. Finally, financial advisors and fund managers should consider both financial risk aversion and sensitivity to impact risk when designing and managing portfolios for clients interested in sustainable investing.

2 Experimental Design

2.1 Types of Assets and Environmental Impact

In our design, we model assets that may not only have a *Financial Return*, but also an *Environmental Impact*. We will refer to these assets as "green" assets. The distribution of financial returns is the classical way to describe risk in financial markets, as it directly affects investors' monetary profits. We study assets with "safe" and "risky" financial returns. The introduction

of a potentially uncertain environmental impact creates an additional source of risk, which may also possess either a "safe" or "risky" nature, yet it does not affect the assets' monetary profits.[2] Instead, it may have an effect on the environment and therefore is related to investors' preferences for sustainable investments. In our study, the environmental impact determines how much CO_2 emissions are ultimately avoided, as a consequence of the investment in an asset.

A special feature of our design is that at the end of our experimental sessions we determine the environmental impacts of all assets and implement them in reality. Specifically, we buy certificates in the European Emissions Trading System (EU ETS) that reduce CO_2 emissions of the same size that was determined by the environmental impact of the assets. To ensure credibility and transparency of implementation, we purchase these certificates through the non-profit organization "Compensators," which operates via an established broker at the Leipzig Power Exchange. Participants were informed in the experimental instructions that they would receive a link after the experiment to access documentation showing precisely how many grams of CO_2 were reduced through their investment decisions. This verifiable mechanism for CO_2 reduction provides high internal validity for our study, as it allows us to precisely control impact risk while maintaining the credibility of actual impact implementation.

2.2 Experimental Structure and Treatments

Overall Design

We employ a combined within- and between-subjects design with two stages. In each stage, participants receive an endowment of 10,000 Experimental Currency Units (ECU) and must allocate it between two assets. We apply an exchange rate of 2,000 ECU = £1. All participants are informed at the beginning that one of the two stages will be randomly selected (with a 50% chance) to be paid after the experiment, avoiding hedging behavior across stages.

All participants first complete stage one, which serves as a baseline measure of financial risk-taking behavior using an investment scenario modeled after Gneezy and Potters (1997). For stage two, participants are randomly assigned with equal probability to either the *Consistent Risks* or *Conflicting Risks* treatment. Participants receive information only about their own

[2]The "green" assets in our experiment should be distinguished from "green" financial products in real markets. In actual markets, assets with high climate risk exposure, for example, may already command a risk premium, affecting their financial risk-return profiles. In contrast, our experimental assets isolate impact risk from financial risks and returns.

assigned treatment.

Stage One: Baseline Assessment of Financial Risk Appetite

In stage one, participants choose between Asset A and Asset B. Asset A is financially safe, where every ECU invested pays a safe financial return of 5% and results in the safe prevention of 0.25 grams of CO_2 emissions. Asset B is financially risky, where every ECU invested carries a 50% chance of yielding either a return of 150% or being entirely lost, and results in the safe prevention of 0.25 grams of CO_2 emissions.

Participants can allocate their endowment between the two assets by selecting any investment amount between 0 and 10,000 ECU for the risky asset, with the remainder automatically placed in the safe asset. Because the environmental impact is identical for both assets, this investment decision provides a measure of financial risk aversion, with lower allocations to the risky asset indicating higher levels of risk aversion (Gneezy and Potters, 1997; Charness et al., 2016).

Stage Two: Introduction of Impact Risk

This stage introduces impact risk to one of the two assets, allowing us to causally test how riskiness of environmental impact affects financial risk-taking. The two treatments differ in which asset carries the impact risk. In the *Consistent Risks* treatment, impact risk is introduced to Asset B, making it consistently "risky" in both financial return and environmental impact. In the *Conflicting Risks* treatment, impact risk is introduced to Asset A, creating a conflict between a safe financial return and a risky environmental impact.

For both treatments, we implement a mean-preserving spread for the impact risk that we introduce in one of the two assets: there is a 50% chance of preventing 0.50 grams of CO_2 emissions and a 50% chance of preventing nothing, maintaining an expected impact of 0.25 grams per ECU (identical to the safe impact). By keeping the expected impact constant across assets, we isolate the pure risk effect of impact on financial risk-taking behavior and avoid simultaneous level effects. Moreover, impact risk is independent from financial risk in our setting. This assumption rules out the possibility that the environmental impact of an asset contains any information regarding its financial performance. Table 1 below presents an overview of our assets with their financial returns, environmental impacts, and their characteristics in terms of financial and impact risks across both stages and treatments.

STAGE ONE:

All participants in Baseline

	Financial Return	Characteristics	Environmental Impact	Characteristics
Asset A	Probability: 1 5% Financial Return	safe	Probability: 1 Prevention of 0.25 grams of CO_2 emissions	safe
Asset B	Probability: 0.5 150% Financial Return Probability: 0.5 Total loss of investment	risky	Probability: 1 Prevention of 0.25 grams of CO_2 emissions	safe

STAGE TWO:

50% chance of participants to receive Treatment - Consistent Risks

	Financial Return	Characteristics	Environmental Impact	Characteristics
Asset A	Probability: 1 5% Financial Return	safe	Probability: 1 Prevention of 0.25 grams of CO_2 emissions	safe
Asset B	Probability: 0.5 150% Financial Return Probability: 0.5 Total loss of investment	risky	Probability: 0.5 Prevention of 0.5 grams of CO_2 emissions Probability: 0.5 No prevention of CO_2 emissions	risky

50% chance of participants to receive Treatment - Conflicting Risks

	Financial Return	Characteristics	Environmental Impact	Characteristics
Asset A	Probability: 1 5% Financial Return	safe	Probability: 0.5 Prevention of 0.5 grams of CO_2 emissions Probability: 0.5 No prevention of CO_2 emissions	risky
Asset B	Probability: 0.5 150% Financial Return Probability: 0.5 Total loss of investment	risky	Probability: 1 Prevention of 0.25 grams of CO_2 emissions	safe

Table 1: Assets and their characteristics. The table shows the assets and their characteristics in terms of financial return and environmental impact for stage one and both treatment arms of stage two of the experiment.

After each stage, we asked participants two verbal questions on 11-point Likert scales. The first question was: *How important was maximizing the financial return to you when you made your investment decision? (0 = not important at all; 10 = very important).* The second question was: *When comparing Asset A and Asset B when you made your investment decision, how risky*

did you perceive Asset B compared to Asset A? (0 = not at all; 10 = very risky). These dual queries, administered before and after the introduction of impact risk, allow us to measure how impact risk causally affects participants' prioritization of financial returns and their comparative risk perception across assets. This before-after comparison isolates the specific effect of impact risk on investment decisions.

After their investment decisions, participants completed a questionnaire measuring economic preferences and psychological factors relevant to investment decisions. To examine perceived social norms (Krupka and Weber, 2013), we included two incentivized questions about investment actions. Participants evaluated the social appropriateness of an action guaranteeing minimal environmental protection, as well as a risky action offering a 50% chance of substantial environmental protection but also a 50% risk of no protection whatsoever.[3] To proxy social-image concerns, we used a question asking participants how likely they are to show their friends the certificate documenting the amount of CO_2 emissions they saved during our experiment. Finally, we verbally assessed participants' climate change concerns, investment priorities regarding CO_2 removal, general risk preferences (Dohmen et al., 2011; Falk et al., 2023), investment experience, altruistic behavior through a hypothetical donation question, time preferences via intertemporal choice questions (Müller and Rau, 2021), guilt sensitivity through social scenarios (Bellemare et al., 2019; Tangney et al., 1996), and financial literacy (Lusardi and Mitchell, 2011).[4] We also collected data on subjects' gender as well as biological sex, their age, their field of study, and their self-assessed investment experience. An overview of all variables and their definitions is provided in Table A1 in Appendix A, and Table A2 delivers descriptive statistics of the variables.

Experimental Procedures

We conducted our online experiment using the Prolific platform (www.prolific.co), which specializes in recruiting participants for academic research. We restricted the sample to UK students to ensure comparability with the large literature in experimental economics on risk-related decision-making that also uses student participants (Druckman and Kam, 2011). Recent finance literature supports this approach, reporting few material differences in investment behavior between stu-

[3] We presented participants with these two questions, where they could earn an additional payment. After the experiment, we randomly selected one of the two questions and determined which response to the question was selected by most participants of the experiment. If participants gave the same response as most participants, they received an additional £0.50. See Appendix B, section "Social Norms" for the questions that we asked.

[4] See Appendix B for the instructions and the detailed questions.

dent and general retail participant pools (e.g., Baule and Muenchhalfen, 2021). Siemroth and Hornuf (2023) likewise report that "job type (e.g., student, self-employed)" does not significantly affect the investments into green projects that their paper studies.

Our sample size is based on a sensitivity power calculation using G*Power by Faul et al. (2007).[5] The experiment was programmed using Qualtrics. To ensure participants understood the experimental design, we implemented comprehension checks (see instructions in Appendix B) that had to be answered correctly before proceeding with the experiment. The data were obtained between September 17$^{\text{th}}$ and 19$^{\text{th}}$ 2024. The average completion time was 18.96 minutes, and participants earned an average of £7.37 (including a show-up fee of £1.50).

3 Hypotheses

The following hypotheses with the experimental design and the pre-analyses plan were pre-registered at OSF before we collected the data.[6] In a first step, we derive a hypothesis about the change in investment behavior when environmental impact risk is introduced at stage two. Irrespective of the treatment, we expect that introducing an additional layer of uncertainty, such as impact risk, increases investors' overall perceptions of the riskiness of an asset. This expectation is motivated by insights from Loewenstein et al.'s (2001) "risk-as-feelings" framework, which suggests that decisions under uncertainty involve both cognitive evaluations and emotional responses that can interact and often directly influence behavior. In our case, with financial and impact risk present, environmental impact uncertainty may trigger emotional reactions related to sustainability values (Riedl and Smeets, 2017; Gutsche and Ziegler, 2019), which could intensify the perceived overall risk of the investment (Loewenstein et al., 2001). Furthermore, since investors typically demonstrate risk aversion across multiple risk domains (Dohmen et al., 2011), we anticipate that this amplified risk perception will manifest in behavioral changes, resulting in reduced investments in assets affected by impact risk in stage two.[7]

[5] Our planned sample of $N = 400$ participants provides adequate statistical power for detecting meaningful effects in our experiment. For within-subject comparisons of investment levels between stages one and two using one-sided matched-pairs tests, we can detect effects as small as Cohen's $d = 0.127$. For between-subject analyses of investment changes across treatments between stages one and two using one-sided Mann-Whitney tests, effects as small as Cohen's $d = 0.255$ can be detected. These calculations assume a significance level of $\alpha = 0.05$ and statistical power of $1 - \beta = 0.80$.

[6] The pre-registration can be found here: osf.io/k4s36.

[7] This behavior is also consistent with the concept of prudence in decision theory (Kimball, 1990), which suggests that individuals respond to increased background risk by making more conservative choices.

Hypothesis 1 (within-subjects effect of impact risk):
If an asset becomes risky with respect to its environmental impact, investors will lower their investments in this asset as compared to the baseline.

In a second step, we derive a hypothesis about potential treatment differences in investment behavior changes between stages one and two. In the *Consistent Risks* treatment, we introduce impact risk to the financially risky asset (Asset B), generally favored by participants with lower risk aversion. Conversely, in the *Conflicting Risks* treatment, impact risk is introduced to the financially safe asset (Asset A), typically preferred by more risk-averse participants. We expect that more risk-averse participants will respond more sensitively to additional impact risk, as their stronger emotional responses to financial risk would likely extend to other dimensions according to the "risk-as-feelings" framework. Since more risk-averse participants naturally concentrate investments in Asset A, the introduction of impact risk to this asset should trigger stronger reactions by disrupting their safe-haven allocation. The effect of introducing impact risk should therefore be more pronounced in the *Conflicting Risks* treatment, where financial safety and impact risk are misaligned.

Hypothesis 2 (between-subjects effect of impact risk):
If an asset becomes risky with respect to its environmental impact, investors' decline in investment is more pronounced under "Conflicting Risks" than under "Consistent Risks".

4 Results

We present our findings in this section, beginning with our main results that test our primary hypotheses through non-parametric tests. These analyses assess within-subjects effects in investment behavior changes between stages one and two, as well as between-subjects comparisons across our two treatment arms. We then investigate investor heterogeneity and potential mechanisms through which impact risk affects participants' prioritization of financial maximization and their risk perception of assets. Finally, we conclude with comprehensive parametric regression analyses of investment behavior changes, incorporating participants' self-reported perceptions, elicited economic preferences, and psychological measures that may influence investment decisions when impact risk is present.

4.1 Main Results

Our paper's main economic question is how impact risk influences investors' financial risk-taking behavior, as measured by investment changes in our within-subjects experiment. We focus on the proportion of endowment allocated between the financially risky asset (Asset B) and the financially safe asset (Asset A). For simplicity, we will refer to these just as "risky asset" and "safe asset" throughout the following analyses. Figure 1 illustrates investors' percentage distribution of the endowment in the asset where impact uncertainty was introduced in stage two. In stage one (striped white bars), all participants provided baseline (BL) valuations. These baseline values are presented conditionally based on the asset where impact risk was introduced (left panel: risky asset in the *Consistent Risks* treatment; right panel: safe asset in the *Conflicting Risks* treatment). As striped white bars show only data from participants who were later assigned to each specific treatment, the stage one values for risky and safe assets do not exactly sum to 100.

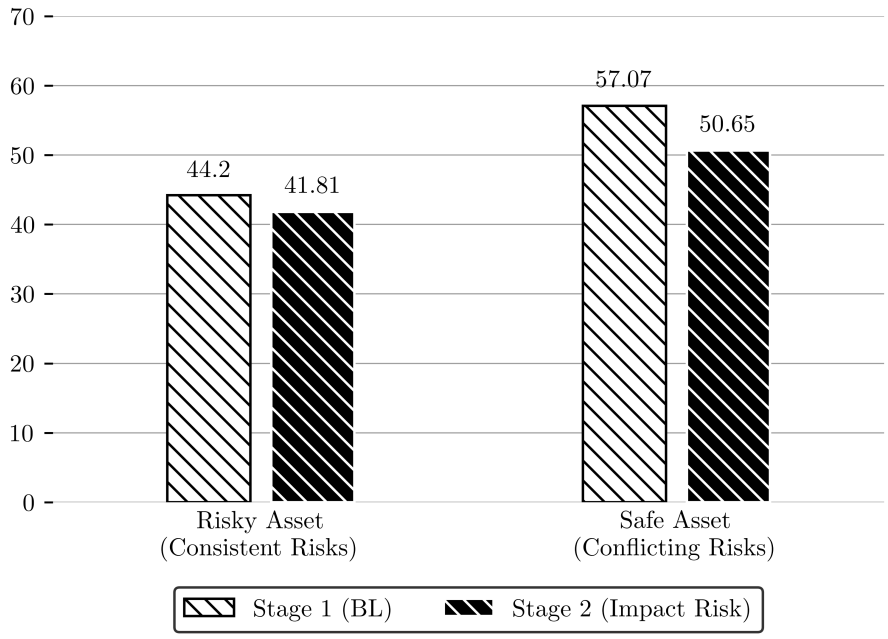

Figure 1: Percentage point allocation in the asset where impact risk was introduced in stage two. Baseline stage (striped white bars) and treatment stage (striped black bars) are conditioned on the asset where impact risk was introduced (left panel: risky asset; right panel: safe asset)

A first finding is that participants demonstrate a slight preference for the safe asset in stage one for both treatments, investing about 55.7% (*Consistent Risks*) and 57.1% (*Conflicting Risks*) of their endowment in the safe asset, respectively. This allocation differs significantly from an

equal 50/50 allocation but is also far away from the extreme allocations of 0/100 and 100/0.

We now examine the results of our pre-registered hypotheses. Notably, investors consistently reduced their shares in assets characterized by impact risk (striped black bars), as compared to the baseline, regardless of whether impact risk was introduced to the financially risky or safe asset. There is a highly significant mean reduction of investments by 4.53 percentage points in assets where impact risk was introduced (1-sided Wilcoxon matched-pairs test, $W = -3.90$, $p < 0.001$). Thus, we find support for Hypothesis 1, which postulated that investors would reduce their investments in assets that become environmentally risky compared to baseline allocations.

A closer look at Figure 1 reveals that this reduction is particularly boosted by the reactions of investors when impact risk was introduced in the financially safe asset in treatment *Conflicting Risks* (right panel). In this case, we observe a relatively strong effect with a mean allocation reduction of 6.42 percentage points (1-sided matched pairs test: $W = -3.62$, $p < 0.001$). By contrast, investors' reaction to impact risk is less pronounced (-2.39 percentage points) but significant (1-sided matched pairs test: $W = -1.74$, $p = 0.041$) when it was introduced in the financially risky asset in treatment *Consistent Risks* (left panel). Comparing the investment reductions in assets characterized by impact risk, we find that the decline is significantly stronger for the safe asset in the *Conflicting Risks* treatment than for the risky asset in the *Consistent Risks* treatment (1-sided Mann-Whitney test, $U = -1.57, p = 0.058$). Thus, we find support for Hypothesis 2, which predicted a more pronounced decline in the *Conflicting Risks* treatment. We summarize our findings as follows.

Result 1 (Investment Changes Under Impact Risk)

(a) Investors significantly reduce their investments in assets characterized by impact risk, regardless of whether this risk was introduced to the financially risky or safe asset.

(b) The reduction in investments is significantly more pronounced when impact risk is introduced to the financially safe asset in the Conflicting Risks treatment.

We now examine the distribution of allocation adjustments (from the baseline to stage two) across our sample. Understanding the full spectrum of investor reactions provides a more complete picture and helps identify whether responses were consistent or varied widely. Figure 2 displays the percentage point changes in investment allocations following the introduction of impact risk, providing insight into the pattern of investor responses at the population level.

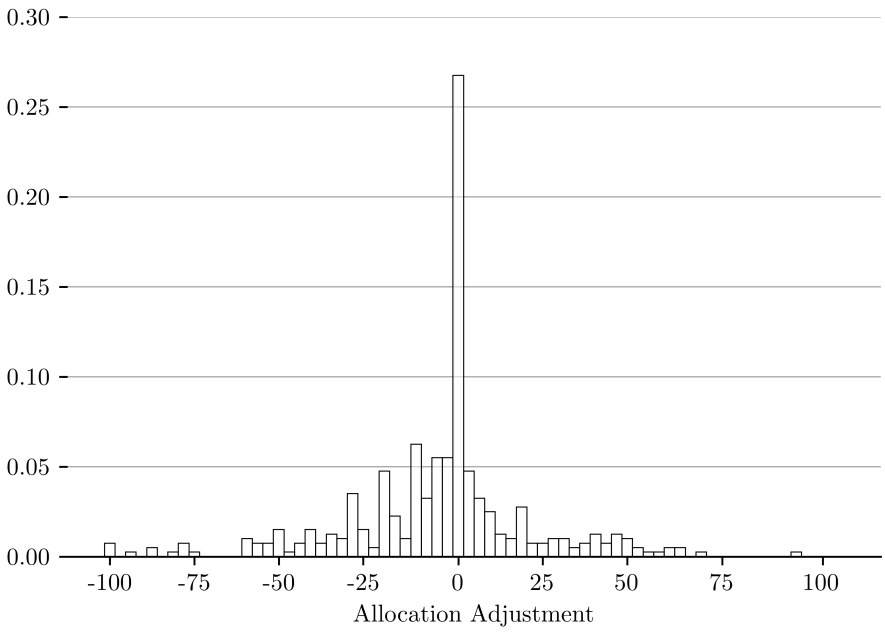

Figure 2: Distribution of the allocation adjustment (in percentage points) for the asset that becomes impact risky.

First, it can be seen that the majority (74.75%) of participants react to the introduction of impact risk and change their asset allocation compared to the baseline. This result clearly indicates impact uncertainty's potential effect on perceived asset risk. Thus, in our online experiment, most participants respond to pure impact risk. Second, changes in asset allocation occur in both directions. While the majority of participants (46.25%) reduces their position in the asset that became environmentally risky, some investors (28.50%) increase their allocation, whereas the smallest share (25.25%) does not react when impact risk is introduced. The divergent changes likely reflect differences in investors' underlying risk preferences and attitudes toward environmental considerations. Given this heterogeneity, a deeper examination of how investors' baseline risk attitudes relate to their subsequent responses to impact risk can provide valuable insights.

4.2 Investor Types' Reactions to Impact Risk

Next, we analyze how investors adjusted their investments in the environmentally risky asset based on their initial degree of financial risk aversion exhibited in the baseline stage.

To conduct this analysis, we focus on the share of endowment invested in the financially risky asset and classify investors using a median split that distinguishes between strong and

weak risk aversion. We categorize investors based on the median investment in the risky asset (40%) during the baseline stage. Those who invested 40% or less of their endowment in the risky asset are classified as "Strong Risk Aversion" types, while those who invested more than 40% are designated as "Weak Risk Aversion" types. Figure 3 illustrates the percentage point changes in investments in the environmentally risky asset across these investor types.

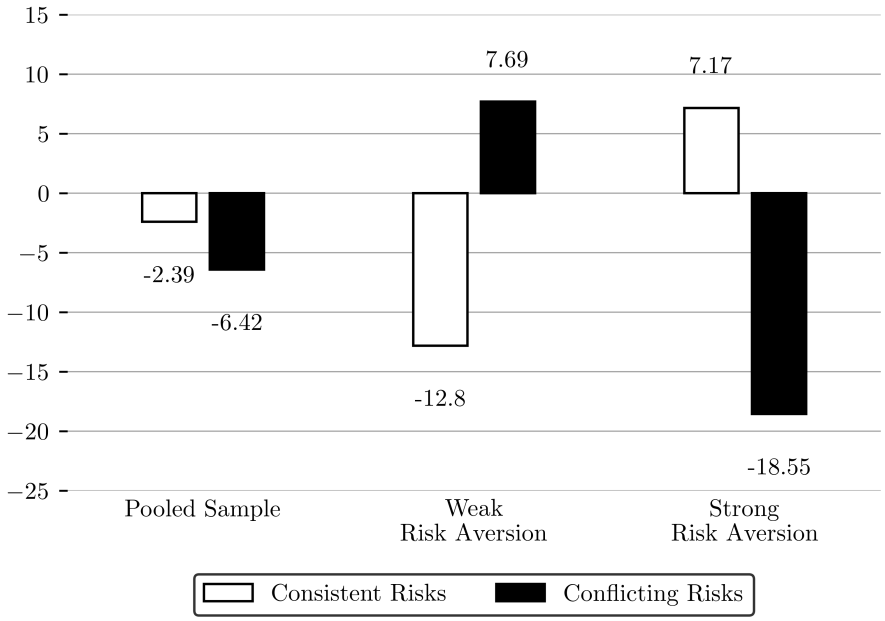

Figure 3: Changes in the share invested in the asset that becomes environmentally risky in stage two (percentage points) by investor risk aversion type: Weak Risk Aversion vs. Strong Risk Aversion. White bars (black bars) indicate decisions of participants assigned to the *Consistent Risks* (*Conflicting Risks*) treatment.

Notably, both risk-aversion types (weak and strong) show their strongest reactions when impact risk is introduced to assets they predominantly invested in during the baseline stage. Specifically, in the *Consistent Risks* treatment, we find that "Weak Risk Aversion" types show the strongest reduction (-12.8 percentage points) of investment in the financially risky asset. In the *Conflicting Risks* treatment, the "Strong Risk Aversion" types show the strongest reduction in the financially safe asset (-18.55 percentage points). Such behavior is intuitively explained by a "Risk Level Effect". If the preferred asset of an investor is hit by impact risk, a large part of the portfolio is affected and the impact risk level of the portfolio is very high. Conversely, if the non-preferred asset is hit, the total impact risk of the portfolio is lower. Therefore, introducing impact risk into the preferred asset is a much stronger shock with respect to the level of portfolio risk, likely triggering stronger reactions. In addition, however, "Strong Risk Aversion" types

exhibit a significantly greater reduction in impact risky asset investments than "Weak Risk Aversion" types (2-sided Mann-Whitney test, $U = -2.16$, $p = 0.031$), demonstrating their heightened sensitivity to the introduction of environmental impact risk and supporting the intuition that led to Hypothesis 2. Thus, we conclude that the overall reduction observed in the pooled sample (-4.53 percentage points) is predominantly driven by the pronounced negative reaction of "Strong Risk Aversion" types in the *Conflicting Risks* treatment (-18.55 percentage points), which is substantially larger than the reactions in other treatment-type combinations.

Though our analysis focuses primarily on the significant investment reductions when impact risk is introduced, we note that a minority of participants (28.5%, as shown in Figure 2) displayed counterintuitive increases in allocation. These isolated cases include some "Weak Risk Aversion" types increasing investments by 7.69 percentage points in the Conflicting Risks treatment and some "Strong Risk Aversion" types increasing by 7.17 percentage points in the Consistent Risks treatment, likely reflecting individual variation rather than systematic effects.

Result 2 (Differential Responses by Risk Aversion Types)
(a) Both risk aversion types show most pronounced negative reactions when impact risk is introduced to assets they predominantly invested in during the baseline stage.
(b) "Strong Risk Aversion" types demonstrate significantly greater sensitivity to environmental impact risk than "Weak Risk Aversion" types, with their pronounced reaction in the Conflicting Risks treatment primarily driving the overall effect in investment reductions.

Having documented the significant changes in investment behavior following the introduction of impact risk, we now examine the mechanisms driving these behavioral responses. In the following section, we leverage our within-subjects experimental design to investigate how impact risk influences investors' perceptions.

4.3 Impact Risk and Investor Perceptions

Our within-subjects design provides a unique opportunity to examine shifts in investors' perceptions following the introduction of impact risk. In this section, we elaborate on this in more detail to detect possible mechanisms on the main findings we observe.

Specifically, with two verbal questions in our experimental design, we measured participants' preferences and perceptions at two points using 11-point Likert scales. First, we assessed their

priority for maximizing financial returns both before (stage one) and after introducing impact risk to one asset (stage two). Second, we evaluated their comparative risk perception of the risky versus safe asset at these same points in time. Both measurements provide insights that relate to concepts from Loewenstein et al.'s (2001) "risk-as-feelings" framework referenced in our hypotheses, serving as proxies to examine whether impact risk influences investors' attention to financial outcomes while also affecting their subjective risk perceptions. Together, these analyses help illuminate the cognitive and emotional processes that may underlie the relationship between impact risk and investment allocation decisions.

Examining investors' self-reported priority (0 = low; 10 = high) for maximizing financial returns, we find that the mean value significantly decreases in both treatments: from 7.52 in the baseline to 7.30 when impact risk was introduced to the risky asset (Consistent Risks; 2-sided Wilcoxon matched-pairs test, $W = 2.341,\ p = 0.0192$) and more pronouncedly from 7.45 to 7.16 when impact risk was introduced to the safe asset (Conflicting Risks; 2-sided Wilcoxon matched-pairs test, $W = 2.860,\ p = 0.004$). The decreased mean values in stage two suggest that the importance to maximize financial returns was lower when uncertainty about the environmental impact was introduced in one asset. This finding aligns with Loewenstein et al.'s (2001) "risk-as-feelings" framework, suggesting that environmental impact uncertainty shifts investors from cognitive evaluation toward more emotion-driven responses to risk. Notably, the more pronounced decline in financial maximization priority when impact risk was introduced to the safe asset aligns with our finding of stronger effects in the *Conflicting Risks* treatment.

Next, we turn to the self-reported comparative risk perception of the risky versus safe asset. Figure 4 illustrates the distributions of investors' self-reported comparative risk perception of the risky versus safe asset, conditional on the baseline stage and the treatment arms of stage two. First, the baseline stage (middle panel "BL") reveals that participants generally perceived the risky asset as riskier than the safe asset. That is, the distribution has higher probability mass in the right part, resulting in a mean perceived riskiness value of 7.79. Interestingly, it turns out that the introduction of impact risk directly affects the comparative risk perception of the assets. As shown in the left panel of the figure, when impact risk is introduced as a potential additional layer of risk for the risky asset in the *Consistent Risks* treatment, the distribution of perceived riskiness shifts further to the right compared to the baseline, yielding a significantly higher perceived mean riskiness value of 8.18 than the baseline stage's 7.79 (2-sided Wilcoxon,

matched-pairs test, $W = -2.845,\ p = 0.004$).

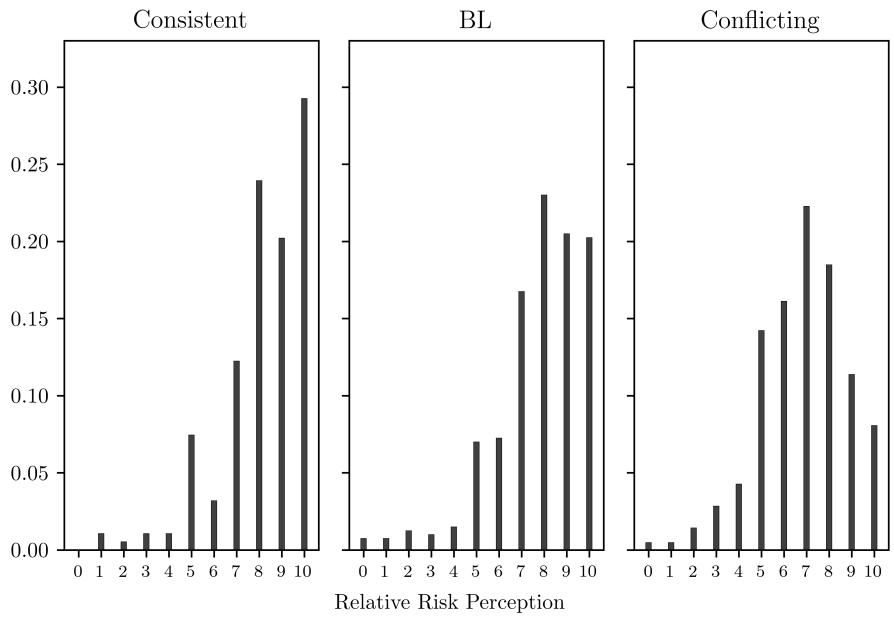

Figure 4: Distributions of self-reported risk perceptions of the financially risky versus financially safe asset. Higher values indicate that the perceived risk of the financially risky asset is higher. The distributions are conditional on treatments.

Remarkably, when impact risk is introduced into the safe asset in the *Conflicting Risks* treatment, an opposite pattern emerges. Precisely, the distribution of perceived riskiness shifts to the left compared to the baseline, yielding a significantly lower perceived mean riskiness value of 6.83 than the baseline stage's 7.82 (2-sided Wilcoxon, matched-pairs test, $W = 6.417,\ p < 0.001$). These significant shifts in risk perception also relate to concepts from Loewenstein et al.'s (2001) "risk-as-feelings" framework, suggesting that environmental impact uncertainty may alter investors' subjective risk assessments beyond purely cognitive evaluations. The opposing directional effects in the two treatments, intensifying perceived riskiness when impact uncertainty affects the already risky asset while diminishing it when affecting the safe asset, illustrate how responses to uncertainty can reshape comparative risk perceptions in ways that align with our observed investment behaviors. We find further support for this when concentrating on correlations between the risk perception measures and participants' investment levels in the risky asset. Specifically, we find negative correlations between perceived riskiness of the risky asset and investment levels in all scenarios: in the baseline stage ($\rho = -0.224,\ p < 0.001$), the *Consistent Risks* treatment ($\rho = -0.215,\ p = 0.003$), and the *Conflicting Risks* treatment

($\rho = -0.147,\ p = 0.032$). These consistent negative correlations between perceived riskiness and investment levels, combined with the systematic differences in risk perception across treatments, suggest a potential causal link between how impact risk changes risk perception and our main finding that investors reduce allocations to assets affected by environmental impact risk. We explore this potential causal relationship more rigorously through multivariate regression analyses in the following section.

Result 3 (Impact Risk and Perception Mechanisms)

(a) Impact risk reduces investors' priority for maximizing financial returns.

(b) Impact risk alters comparative risk perceptions in opposite directions depending on which asset becomes environmentally risky: perceived riskiness of the risky asset increases when impact risk affects the financially risky asset and decreases when it affects the financially safe asset.

(c) Risk perception is consistently negatively correlated with investment levels across all stages.

4.4 Multivariate Analyses and Risk Perception Chanel

Our analyses revealed that investors significantly reduce allocations to assets that become environmentally risky, with this effect particularly pronounced in the *Conflicting Risks* treatment where impact uncertainty affects the financially safe asset. To gain deeper economic insights and explore potential causal mechanisms, we employ multivariate regression analyses, building on our key findings: treatment differences (Figure 1), heterogeneous individual responses (Figure 2), differential effects based on risk preferences (Figure 3), and investors' changed asset perceptions due to impact risk (Figure 4). We then examine three central questions. First, we assess the relative explanatory power of these effects when considered simultaneously. Second, we test the robustness of our findings by incorporating various individual characteristics as control variables. Finally, we investigate whether differences in participants' focus on maximizing financial returns and changes in risk perception mediate the relationship between impact uncertainty and investment decisions, potentially providing causal mechanisms for our results.

To test our hypotheses within a regression framework, we construct orthogonal explanatory variables capturing the effects documented in our previous analyses. In specification (1), we include an intercept vector that captures the mean change in asset allocation due to impact risk. We incorporate a variable measuring the mean difference between treatments (*Conflicting*

versus *Consistent*) as a treatment dummy indicator but adjusted to ensure orthogonality with the intercept by accounting for the relative proportion of participants in each treatment group. For all regression specifications, we report significance levels for main variables (*Constant*, *Treatment: Conflicting Risks*) based on one-sided tests, reflecting our directional hypotheses that predict investment reductions when impact risk is introduced.

Dependent Variable: Investment Change (impact risky asset)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-0.0453***	-0.0453***	-0.0443**	-0.0383*	-0.0285	-0.0243
	(0.013)	(0.012)	(0.023)	(0.023)	(0.023)	(0.023)
Treatment: Conflicting Risks	-0.0403*	-0.0403**	-0.0367*	-0.0358*	-0.0231	-0.0228
	(0.027)	(0.024)	(0.025)	(0.025)	(0.025)	(0.025)
Consistent×*Strong Risk Aversion*		0.1997***	0.1928***	0.1939***	0.1748***	0.1761***
		(0.035)	(0.036)	(0.036)	(0.035)	(0.035)
Conflicting×*Strong Risk Aversion*		-0.2625***	-0.2658***	-0.2646***	-0.2416***	-0.2412***
		(0.033)	(0.034)	(0.034)	(0.034)	(0.034)
Diff. Fin. Opt.				0.0127*		0.0099
				(0.008)		(0.007)
Diff. Risk Perception					-0.0256***	-0.0250***
					(0.006)	(0.006)
Controls			*yes*	*yes*	*yes*	*yes*
N	400	400	385	385	384	384
adj. R^2	0.003	0.192	0.192	0.196	0.224	0.226

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: OLS regressions analyses. The dependent variable *Investment Change* measures the change in the percentage point investment into the asset that becomes impact risky. Negative values indicate a reduction in the impact risky asset. Significance levels for main variables (*Constant*, *Treatment: Conflicting Risks*) are based on one-sided tests due to directional hypotheses.

Specification (1) in Table 2 confirms our hypotheses H1 and H2 in a multivariate framework. The constant captures the mean allocation reduction of 4.53 percentage points when impact risk is introduced, while the *Treatment* variable shows the 4.03 percentage point difference between *Conflicting Risks* and *Consistent Risks* treatments. Both effects are statistically significant, at the 1% and 10% levels, respectively. Specification (2) incorporates risk aversion effects. Therefore, we add interaction terms between treatments and risk-aversion types: *Consistent*×*Strong Risk Aversion* and *Conflicting*×*Strong Risk Aversion*. The *Strong Risk Aversion* dummy equals 1 for participants with relatively strong risk aversion and 0 for those with weak risk aversion.[8]

[8]These interaction terms are also adjusted to account for the proportion of participants in each of the four subgroups, maintaining orthogonality of the regressors.

Results show that strongly risk-averse investors react differently than weakly risk-averse investors by 19.97 percentage points in the *Consistent Risks* treatment and by -26.25 percentage points in the *Conflicting Risks* treatment. The inclusion of these interaction terms substantially increases the adjusted R^2, highlighting the importance of accounting for investor heterogeneity. Specification (3)–(6) incorporate control variables. To avoid multicollinearity, we use principal components constructed from the variables in Table A1, which include our post-experimental economic preferences, psychological measures and demographic information collected after the investment decisions, while excluding our primary perception variables (*Diff. Fin. Opt.* and *Diff. Risk Perception*).[9] When controls are added, the explanatory power remains unchanged, suggesting that these additional variables contribute little to explaining allocation changes. The parameter estimates from Specification (2) retain their signs and significance.

Specification (4) incorporates our first potential mediator, the difference in participants' priority for maximizing financial returns (*Diff. Fin. Opt.*) between stages one and two. This variable serves as one of our potential proxies for the mechanisms described in Loewenstein et al.'s (2001) "risk-as-feelings" framework. As expected, we find that reduced emphasis on financial returns is associated with reduced investment in the impact-risky asset (significant at the 10% level). However, all variables from Specification (3) remain statistically significant. Specification (5) introduces our second mediator, the difference in risk perception between stages one and two (*Diff. Risk Perception*). This variable captures how the introduction of impact uncertainty alters investors' subjective assessment of asset riskiness. The strong negative coefficient (significant at the 1% level) indicates that increased risk perception leads to substantial reductions in allocations to the impact-risky asset. Importantly, both the constant and treatment variables lose their statistical significance when this mediator is included, while the interaction terms remain significant.[10] The remaining significance of the interactions terms is consistent with the importance of the "Risk Level Effect" because the question about risk perception refers to the relative risk of the two assets and not to the overall risk of the portfolio. Overall, the observed pattern suggests that changes in risk perception substantially mediate the effect of

[9] Principal component analysis suggests four components with eigenvalues larger than 1. We include these four components along with *High Fin. Literacy* and *Female* variables separately, as their binary nature makes them unsuitable for the principal component analysis. See table A4 in the appendix for more information.

[10] Mediation analysis using the product of coefficients method indicates that both of our main effects (the introduction of impact risk and the treatment effect) are mediated by the difference in risk perception. The mediation analysis suggests similar outcomes for both effects. We find significant indirect effects on the allocation adjustment via the difference in risk perception. The direct effect looses significance once the risk perception channel is introduced. Figure A.1 & A.2 in the appendix display the mediation analysis in more detail.

impact uncertainty on investment decisions, indicating that impact risk likely operates, at least in part, by altering investors' subjective perception of overall asset risk. These findings suggest that while changes in financial prioritization play a role, the primary channel through which impact risk affects investment behavior appears to be the alteration of investors' subjective risk perceptions. Specification (6) provides additional evidence on this issue. If both (*Diff. Fin. Opt.*) and (*Diff. Risk Perception*) are included in the regression model, the strong risk perception effect remains while financial prioritization becomes insignificant, underlining the relatively minor role of financial prioritization as compared to risk perception in the decision to divest from the impact-risky asset.

Result 4 (Mediating Mechanisms of Impact Risk)
(a) The main finding of reduced investments in the presence of impact risk, together with the responses of risk aversion types, remain robust after controlling for individual characteristics.
(b) The effect of impact risk on investment allocation is primarily mediated through changes in investors' subjective risk perceptions.

5 Conclusion

This paper investigates the effects of uncertain environmental impact on risk taking in asset allocation. We use a pre-registered and incentivized online experiment where participants had to allocate wealth between two assets, one with safe payments and another with risky payments. The holding of assets has additional non-financial effects in terms of CO_2 reductions, implemented via the retirement of emission certificates under the EU Emissions Trading System. The crucial feature of our experiment is that we have full control about the distribution of environmental impact and can reliably communicate it to the participants. Specifically, to ensure credibility and transparency of this environmental implementation, we purchase these certificates through the non-profit organization "Compensators," which operates via an established broker at the Leipzig Power Exchange. Participants of our experiment knew that they would receive a link after the experiment to access documentation showing how many grams of CO_2 were reduced through their investments. Our framework, which precisely implements the withdrawal of these certificates, allows us to introduce experimental treatments that alter only the impact risk of our assets—without affecting the expected level of impact or the expected distribution

of financial returns. This design enables us to isolate and examine participants' behavioral responses to pure impact risk, making our study the first to document such reactions.

A main finding is that the majority of participants does react to the introduction of impact risk. On average, this reaction is negative, i.e., participants reduce their investments in the asset that becomes impact risky in our within-subjects design. This finding hints to risk-averse behavior with respect to impact risk. However, reactions are heterogeneous. In particular, there are stronger reactions to impact risk if it is introduced to an asset that does not align well with the financial risk preferences of the participants. We show such a treatment effect via a between-subjects comparison. Notably, the main effect is primarily driven by "Strong Risk Averse" types in the *Conflicting Risks* treatment, who exhibit a pronounced reduction in investments when impact risk is introduced to the financially safe asset. This finding aligns with the ideas of Loewenstein's "risk-as-feelings" framework, which suggests that decision-making under uncertainty may involves emotional responses that can directly influence behavior. Our results support this perspective, as we observe a shift away from purely financial considerations towards non-financial aspects and potentially more emotion-driven risk assessments when assets carry environmental impact risk. This is evidenced by two key mediating mechanisms: first, a decreased emphasis on maximizing financial returns, and second, a significant change in risk perception of impact-risky assets. Our regression analyses revealed that the increased perceived riskiness of assets that became impact risky explains the observed investment behavior changes, providing causal evidence that the documented effects are driven by changes in participants' risk perceptions due to impact risk. The findings remain consistent when we add several control variables, underscoring the robustness of our main results.

A potential alternative explanation for our findings could be that investors are simply reverting toward some mechanical allocation rule rather than responding to impact uncertainty. However, several aspects of our results contradict this interpretation. First, the significantly stronger reduction exhibited by "Strong Risk Aversion" types compared to "Weak Risk Aversion" types demonstrates a genuine differential sensitivity to impact uncertainty rather than mere mechanical portfolio adjustments. Second, if participants were simply reverting to certain allocations, we would expect more symmetrical patterns of adjustment across treatments and investor types, which is not what we observe.

Although an important goal of our study was to particularly achieve a high degree of inter-

nal validity, the results have also important practical implications. Our findings demonstrate that impact risk causes changes in portfolio composition that can be very substantial. Moreover, it matters whether impact risk occurs in an asset that is financially safe as compared to an asset that is already risky in the financial dimension. It also matters whether impact risk affects assets that make up a larger or smaller proportion of a portfolio. Financial advice needs to take these issues into account. Moreover, if impact risk could be reduced, for example, via greater transparency of green assets and reliable green labels, investors' already complicated risk-return trade-off in the financial domain would not be further disturbed by impact uncertainty. Furthermore, our findings have several implications for investment firms and market structure. Investment firms may develop more sophisticated approaches to sustainable investing that could explicitly account for impact uncertainty, potentially integrating impact risk assessments into standard risk profiling tools. Regulatory bodies may need to consider mandating more comprehensive disclosure requirements that transparently communicate both financial and environmental impact risks. Additionally, our research suggests the potential for developing new financial products and risk assessment frameworks that explicitly model and price environmental impact risk, which could help investors make more informed decisions and potentially reduce the emotional cognitive dissonance associated with sustainable investing.

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Appendix A Additional Information on the Data Set

Variable	Scale	Range	Definition
Fin. Opt.	11-point Likert item	[0,10]	0 = not important to maximize financial return 10 = very important to maximize financial return
Risk Perception	11-point Likert item	[0,10]	0 = Asset B not risky compared to Asset A 10 = Asset B very risky compared to Asset A
Diff. Fin. Opt.	continuous	[-10,10]	Stage 2: Fin Opt. − Stage 1: Fin. Opt.
Diff. Risk Perception	continuous	[-10,10]	$= \begin{cases} \text{Stage 1} - \text{Stage 2 for Conflicting} \\ \text{Stage 2} - \text{Stage 1 for Consistent} \end{cases}$
Social Norm Safe	4-point	[0,3]	0 = very socially inappropriate 3 = very socially appropriate
Social Norm Risky	4-point	[0,3]	0 = very socially inappropriate 3 = very socially appropriate
Social Image	11-point Likert item	[0,10]	0 = very unlikely 10 = very likely
Risk	11-point Likert item	[0,10]	0 = completely unwilling 10 = completely willing
Inv Exp	11-point Likert item	[0,10]	0 = not experienced 10 = very experienced
Altruism	11-point	[0,10]	-
Patience	continuous	$[-1.000, 1.000]$	Time equivalent today − Time equivalent in 6 months
Guilt	index	[0,10]	equally-weighted Guilt1, Guilt2, Guilt3
High Fin. Literacy	binary	{0,1}	$= \begin{cases} 1 \text{ for} \sum FinLit_i = 3 \\ 0 \text{ otherwise} \end{cases}$
Female	binary	{0,1}	$= \begin{cases} 1 \text{ for Female} \\ 0 \text{ for Male} \end{cases}$
Age	open-text	-	-

Table A1: Overview of variables. *Fin. Opt.* measures the importance to maximize financial return. This variable is obtained in the baseline and the treatment stages. *Risk Perception* measures the perceived risk in comparison between the financially risky asset (Asset B) and the financially safe asset (Asset A). This variable is obtained in the baseline and the treatment stages. *Diff. Fin. Opt.* measures the change in the objective to maximize financial returns between the stages. Negative values indicate a lower preference to maximize financial returns in the treatment stage as compared to the baseline. *Diff. Risk Perception* measures the change in the perceived riskiness of Asset B compared to Asset A once impact risk is introduced. The variable is coded such that positive values indicate an increase in perceived riskiness for the asset that becomes impact risky. *Social norm* measures correspond to the measures used in Krupka and Weber (2013). The *General Risk Taking*, *Altruism* and *Patience* measures correspond to the measures suggested in Falk et al. (2023). The *Patience* measure is the difference of the time equivalent of waiting 6 months to receive £1.000 from today's perspective and the perspective in 6 months. *Guilt* is indexed as the equally-weighted sum of answers to the corresponding questions in the post-experimental survey. *High. Fin. Literacy* is coded such that participants that wished to answer and correctly answered three items from the original questionnaire of Lusardi and Mitchell (2011). *Female* indicates female participants. We excluded those participants that chose not to answer or stated a non-binary gender. The remainder of control variables are measured as stated in the questionnaire.

	N	Mean	SD	Median	Min	Max
Treatment Conflicting	400	0.53	0.50	1.00	0.00	1.00
Stage 1: Risky Asset	400	0.44	0.30	0.40	0.00	1.00
Stage 1: Fin. Opt.	400	7.49	1.96	8.00	1.00	10.00
Stage 1: Risk Perception	400	7.79	1.96	8.00	0.00	10.00
Diff. Fin. Opt.	400	−0.26	1.64	0.00	−8.00	7.00
Diff. Risk Perception	399	0.70	2.06	0.00	−9.00	10.00
Social Norm Safe	400	2.14	0.74	2.00	0.00	3.00
Social Norm Risky	400	1.36	0.80	1.00	0.00	3.00
Social Image	400	5.41	2.77	6.00	0.00	10.00
General Risk Taking	399	5.93	2.19	6.00	1.00	10.00
Investment Exp.	400	4.62	2.63	5.00	0.00	10.00
Altruism	396	2.93	2.42	2.00	0.00	10.00
Patience	393	−16.85	159.59	0.00	−850.00	814.00
Guilt	400	7.16	1.80	7.33	1.00	10.00
Age	400	28.46	9.10	27.00	18.00	63.00
High Fin. Literacy	400	0.48	0.50	0.00	0.00	1.00
Female	397	0.49	0.50	0.00	0.00	1.00

Table A2: Descriptive Statistics. N is the number the observations for each variable with observations smaller 400 indicating missing answers. Participants responding to all of the above items amount to $N = 384$. *Treatment* defines assignment to the *Conflicting Risks* treatment. The corresponding mean measures the proportion of participants assigned to the *Conflicting Risks* treatment.

Variables	Conflicting	Consistent	Mann-Whitney U
Stage 1: Risky Asset	0.43	0.44	.61
Stage 1: Fin. Opt.	7.45	7.52	.92
Stage 1: Risk Perception	7.79	7.79	.71
Social Norm Safe	2.11	2.18	.35
Social Norm Risky	1.36	1.36	.94
Social Image	5.30	5.53	.42
General Risk Taking	5.95	5.90	.82
Investment Exp.	4.64	4.61	.69
Altruism	2.88	2.98	.45
Patience	−29.03	−3.02	.20
Guilt	7.05	7.28	.16
Age	29.28	27.53	.35
High Fin. Literacy	0.44	0.53	.08
Female	0.45	0.54	.08

Table A3: Summary statistics by treatment. Columns *Conflicting* and *Consistent* represent mean values by treatment and variable. The column *Mann-Whitney U* reports the two-sided p-value of the eponymous non-parametric test for differences between the treatment groups.

Panel A: Eigenvalues

	(1)	(2)	(3)	(4)
Eigenvalue	1.9069	1.3199	1.1608	1.0385
Proportion of Variance	0.2119	0.1467	0.1290	0.1154
Cumulative Variance	0.2119	0.3585	0.4875	0.6029

Panel B: Loadings

	(1)	(2)	(3)	(4)
Social Norm Safe	−0.1629	0.4427	0.3616	−0.0094
Social Norm Risky	−0.0308	0.5130	0.2219	−0.5026
Social Image	0.5110	−0.0437	0.2221	−0.0435
General Risk Taking	0.5073	0.2340	−0.2578	−0.0432
Investment Exp.	0.5120	0.0366	−0.2520	0.0080
Altruism	0.4293	−0.0515	0.3718	−0.0682
Patience	0.0274	0.3368	−0.1623	0.7580
Guilt	0.0811	−0.0633	0.6778	0.4008
Age	0.0153	−0.6023	0.1294	−0.0606
N		388		

Table A4: Principal Component Analysis. Panel A summarizes the four components fulfilling the Kaiser-Guttman criterion displaying the Eigenvalues and the proportion of explained variation. Panel B displays the factor loadings of each component.

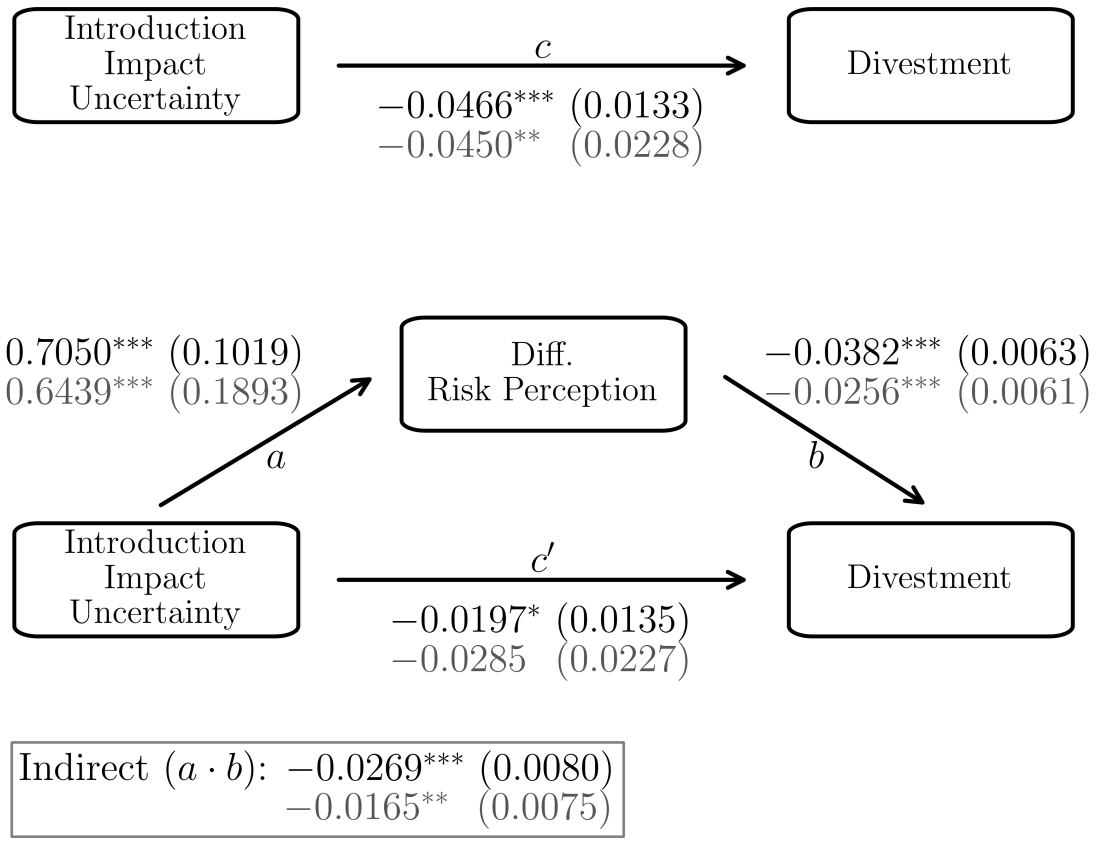


Figure A.1: Risk perception as a mediator of divestment. Mediation paths of the changes in participants' risk perception between stages one and two, explaining the treatment effects (Introduction Impact Uncertainty) in terms of divestment in the impact-risky asset. Reported path values are OLS regression coefficients with standard errors in parentheses. Standard errors for the indirect effect ($a \cdot b$) were obtained via bootstrapping. Black color represents the unconditional model and gray color represents the conditional model using control variables. Significance levels are: *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$.

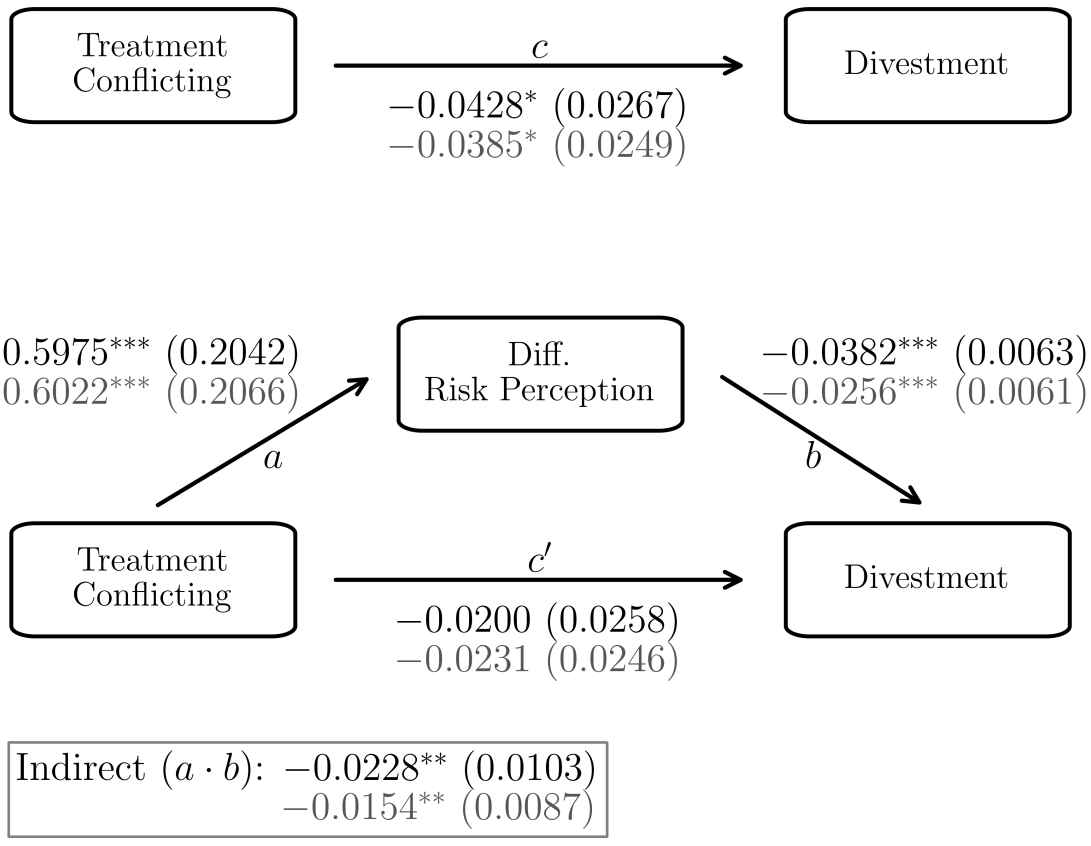


Figure A.2: Risk perception as a mediator of the treatment effect on divestment. Mediation paths of the changes in participants' risk perception between stages one and two, explaining the effect of differential treatment (*Conflicting Risks* and *Consistent Risks*) in terms of divestment in the impact-risky asset. Reported path values are OLS regression coefficients with standard errors in parentheses. Standard errors for the indirect effect $(a \cdot b)$ were obtained via bootstrapping. Black color represents the unconditional model and gray color represents the conditional model using control variables. Significance levels are: *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$.

Appendix B Survey

Intro

Welcome

This is an academic experiment on investment decision-making. Completing the entire experiment should not take more than a few minutes.

The reward for participating in this experiment is £1.50, but a large share of your compensation will be paid in the form of a bonus payment. This bonus payment is determined by your decisions taken in the experiment. Please note that this experiment is intended exclusively for Prolific participants.

Information on data processing

The data are collected exclusively for scientific purposes. The experimental data collected in this study are completely anonymous, i.e. they do not allow any conclusions to be drawn about your person in accordance with Prolific's guidelines. The processing is carried out by researchers at the University of Göttingen (Germany). As part of the publication of the study results in scientific journals, the results of statistical evaluations are published in summarized form; conclusions about individual persons are always excluded. Participation is of course voluntary. You are free to cancel your participation at any time without giving reasons. However, in this case you will not receive money. Put differently, to be paid you need to complete the entire experiment.

If you have questions, you can contact: oliver.frensch@uni-goettingen.de

Please consent to our terms if you would like to participate in this study. If you prefer not to take part, please proceed to the "Next Page" without ticking the terms of our study.

Note that we cannot pay the participants before the whole experiment was finished. Therefore, it may take a few days until you receive your payments.

◯ I hereby consent to the data processing, the confidentiality and participation in the study.

Consent Fail

You did not consent to our experimental conditions and are not eligible for the study.

On the next page you will be redirected to Prolific.

Prolific Questions

Please enter your Prolific ID.

Sequence

Sequence of the Experiment

The experiment consists of two parts, where you make decisions that affect your payments in this experiment. Before the start of each part, you will always receive on-screen instructions about the decisions in this part. At the end of the experiment, a coin flip decides with a 50% probability whether you receive the earnings of part 1 or part 2. In the very end, you will participate in a post-experimental questionnaire.

Throughout the whole experiment, you can earn money in the form of “Experimental Currency Units” (ECU). At the end of the experiment, the ECUs you have earned will be converted into British pounds. The following exchange rate applies:

2,000 ECU = £1

You will receive your payment via Prolific's payment system. The additional earnings will be paid through the Prolific bonus payment system. Note that we cannot pay the participants before the whole experiment was finished. Therefore, it may take a few days until you receive your payments.

Part1 - Intro

Part 1

In part 1 of the experiment, you have an endowment of 10,000 ECU. In what follows, you are required to invest your whole endowment. In this context, you must decide how to divide this amount between two assets by moving a slider.

Investing in the two assets may yield a financial return and has non-financial effects by leading to a reduction of CO2 emissions. The total levels of the possible financial return and CO2 reductions depend on the amount of ECU that you invested in the assets. The assets have the following characteristics:

Asset A

Financial Return:

- **With certainty**: Every ECU invested pays out a return of 5%. That is, every 100 ECU invested yield 105 ECU.

Non-Financial Effect:

- **With certainty**: Every ECU invested leads to a reduction in CO2 emissions. Specifically, every 100 ECU invested result in the prevention of 25 grams of CO2 emissions. We implement this reduction by buying and retiring EU CO2-emission certificates. (click here for more information on the EU Emission Trading System)

Asset B

Financial Return:

- **With 50% probability (good state)**: Every ECU invested pays out a return of 150%. That is, every 100 ECU invested yield 250 ECU.
- **With 50% probability (bad state)**: Your investment is lost.

Non-Financial Effect:

- **With certainty**: Every ECU invested leads to a reduction in CO2 emissions. Specifically, every 100 ECU invested result in the prevention of 25 grams of CO2 emissions. We implement this reduction by buying and retiring EU CO2-emission certificates. (click here for more information on the EU Emission Trading System)

If in the end of the experiment, part 1 will be selected to be payoff-relevant, you will be paid according to your investments in Assets A and B. Specifically, for Asset B the computer will conduct **a random draw** to determine the state (good or bad) of the financial return. Moreover, the non-financial effect of your investments in part 1 will also be processed.
In a few days, you will receive an official PDF that documents the level of CO2 that you prevented.

Based on the information you have just read, which consequences will your investment in Asset A and B have? Please choose the correct financial and non-financial implications of your investment.
If you are not sure, please re-read the study information above. You will have two opportunities to get these questions correct.

*For every 100 ECU you invest in **Asset B**...*

◯ you receive 250 ECU in a good state and 0 ECU in a bad state.

- you receive 105 ECU in a good state and 105 ECU in a bad state.
- you receive 0 ECU in a good state and 250 ECU in a bad state.
- You receive 250 ECU in a good state and 250 ECU in a bad state.

*For every 100 ECU you invest in **Asset A and Asset B**...*

- you do not achieve any real CO2 reductions.
- you achieve a hypothetical CO2 reduction of 25 grams with no real reductions.
- you achieve a real CO2 reduction of 25 grams and receive a document certifying the reduction.
- you achieve a real CO2 reduction of 1.000 kilograms.

On the next screen, you can make your allocation decision between the two assets by moving a slider. Press "Next Page" to proceed to the next screen.

Comprehension Fail

You failed the comprehension check. There is **one more opportunity** left to pass the check.
On the next screen you will be able to re-read the description of the assets and answer the comprehension check(s). Press "Next Page" to proceed to the next screen.

Comprehension Fail2

We are sorry to tell you that you are ineligible for this study as you have failed the comprehension check which is necessary to understand the study design.
On the next page you will be redirected to Prolific and we kindly ask you to return your submission.

Part1 - Decision

Investment Decision

Please choose how much ECU you want to invest in Asset A and Asset B.

Asset A Asset B

Asset A	**Asset B**
Financial Return	
Please adjust the slider to see your outcome	Please adjust the slider to see your outcome
Non-financial effect	
Please adjust the slider to see your outcome	Please adjust the slider to see your outcome

Please make your adjustments and click "Next Page" if you are happy with them.

Please answer the following questions:

1. *How important was maximizing the financial return to you when you made your investment decision?*

   [0 = not important at all; 10 = very important]

not important very important

0 1 2 3 4 5 6 7 8 9 10

2. *When comparing Asset A and Asset B when you made your investment decision, how risky did you perceive Asset B compared to Asset A?*

   [0 = not at all; 10 = very risky]

not risky very risky

0 1 2 3 4 5 6 7 8 9 10

Part2a - Intro

Part 2

In part 2 of the experiment, you again have an endowment of 10,000 ECU. In what follows, you are required to invest your whole endowment. In this context, you again must decide how to divide this amount between two assets by moving a slider.

Investing in the two assets may yield a financial return and may have non-financial effects by leading to a reduction of CO2 emissions. The total levels of the possible financial return and CO2 reductions depend on the amount of ECU that you invested in the assets. The assets have the following characteristics:

Asset A

Financial Return:

- **With certainty**: Every ECU invested pays out a return of 5%. That is, every 100 ECU invested yield 105 ECU.

Non-Financial Effect:

- **With certainty**: Every ECU invested leads to a reduction in CO2 emissions. Specifically, every 100 ECU invested result in the prevention of 25 grams of CO2 emissions. We implement this reduction by buying and retiring EU CO2-emission certificates. (click here for more information on the EU Emission Trading System)

Asset B

Financial Return:

- **With 50% probability (good state)**: Every ECU invested pays out a return of 150%. That is, every 100 ECU invested yield 250 ECU.
- **With 50% probability (bad state)**: Your investment is lost.

Non-Financial Effect:

- **With 50% probability (good state)**: Every ECU invested leads to a reduction in CO2 emissions. Specifically, every 100 ECU invested result in the prevention of 50 grams of CO2 emissions. We implement this reduction by buying and retiring EU CO2-emission certificates. (click here for more information on the EU Emission Trading System)
- **With 50% probability (bad state)**: Your investment does not lead to a reduction in CO2 emissions.

If in the end of the experiment part 2 will be selected to be payoff-relevant, you will be paid according to your investments in Assets A and B. Specifically, for Asset B the computer will conduct **one random draw** to determine the state (good or bad) of the financial return. Moreover, for Asset B the computer will conduct **another random draw** to determine the state (good or bad) of the non-financial effect.

Thus, four combinations are possible for Asset B:

1. The **financial** return of Asset B is at "**good**" state and the **non-financial** effect of Asset B is at "**good**" state.
2. The **financial** return of Asset B is at "**bad**" state and the **non-financial** effect of Asset B is at "**good**" state.
3. The **financial** return of Asset B is at "**good**" state and the **non-financial** effect of Asset B is at "**bad**" state.
4. The **financial** return of Asset B is at "**bad**" state and the **non-financial** effect of Asset B is at "**bad**" state.

In a few days, you will receive an official PDF that documents the level of CO2 that you prevented.

Your investment in Asset B may still have the non-financial effect of a real CO2 reduction together with the receipt of a certificate documenting the reduction. Based on the information you have just read, what are the exact characteristics that the non-financial effect of your investment in Asset B has? Please choose the correct non-financial implication of your investment.

If you are not sure, please re-read the study information above. You will have two opportunities to get this question correct.

*For every 100 ECU you invest in **Asset B**...*

- ◯ you achieve a CO2 reduction of 25 grams in a good state of the non-financial effect and 25 grams in a bad state of the non-financial effect.
- ◯ you achieve a CO2 reduction of 50 grams in a good state of the non-financial effect and 50 grams in a bad state of the non-financial effect.
- ◯ you achieve a CO2 reduction of 50 grams in a good state of the non-financial effect and 0 grams in a bad state of the non-financial effect.
- ◯ you achieve a CO2 reduction of 0 grams in a good state of the non-financial effect and 50 grams in a bad state of the non-financial effect.

On the next screen, you can make your allocation decision between the two assets by moving a slider. Press “Next Page” to proceed to the next screen.

Part2a - Decision

Investment Decision

Please choose how much you want to invest in Asset A and B.

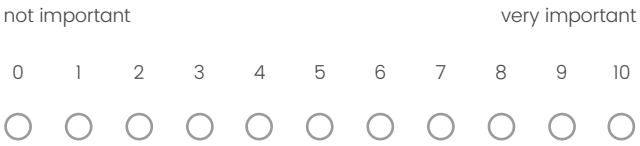
Asset A	**Asset B**
Financial Return	
Please adjust the slider to see your outcome	Please adjust the slider to see your outcome
Non-financial effect	
Please adjust the slider to see your outcome	Please adjust the slider to see your outcome

Please make your adjustments and click "Next Page" if you are happy with them.

Please answer the following questions:

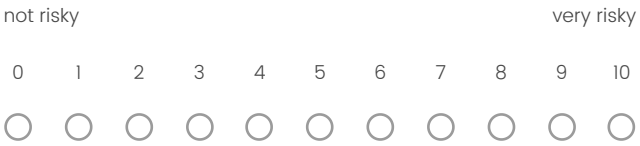
1. *How important was maximizing the financial return to you when you made your investment decision in Part 2?*

   [0 = not important at all; 10 = very important]



2. *When comparing Asset A and Asset B when you made your investment decision in Part 2, how risky did you perceive Asset B compared to Asset A?*

   [0 = not at all; 10 = very risky]



Part2b - Intro

Part 2

In part 2 of the experiment, you again have an endowment of 10,000 ECU. In what follows, you are required to invest your whole endowment. In this context, you again must decide how to divide this amount between two assets by moving a slider.

Investing in the two assets may yield a financial return and may have non-financial effects by leading to a reduction of CO2 emissions. The total levels of the possible financial return and CO2 reductions depend on the amount of ECU that you invested in the assets. The assets have the following characteristics:

Asset A

Financial Return:

- **With certainty**: Every ECU invested pays out a return of 5%. That is, every 100 ECU invested yield 105 ECU.

Non-Financial Effect:

- **With 50% probability (good state):** Every ECU invested leads to a reduction in CO2 emissions. Specifically, every 100 ECU invested result in the prevention of 50 grams of CO2 emissions. We implement this reduction by buying and retiring EU CO2-emission certificates. (click here for more information on the EU Emission Trading System)
- **With 50% probability (bad state):** Your investment does not lead to a reduction in CO2 emissions.

Asset B

Financial Return:

- **With 50% probability (good state)**: Every ECU invested pays out a return of 150%. That is, every 100 ECU invested yield 250 ECU.
- **With 50% probability (bad state)**: Your investment is lost.

Non-Financial Effect:

- **With certainty:** Every ECU invested leads to a reduction in CO2 emissions. Specifically, every 100 ECU invested result in the prevention of 25 grams of CO2 emissions. We implement this reduction by buying and retiring EU CO2-emission certificates. (click here for more information on the EU Emission Trading System)

If in the end of the experiment part 2 will be selected to be payoff-relevant, you will be paid according to your investments in Assets A and B. Specifically, for Asset B the computer will conduct **one random draw** to determine the state (good or bad) of the financial return. Moreover, for Asset A the computer will conduct **another random draw** to determine the state (good or bad) of the non-financial effect.

Thus, four combinations are possible for Asset B and Asset A:

1. The **financial** return of Asset B is at "**good**" state and the **non-financial** effect of Asset A is at "**good**" state.
2. The **financial** return of Asset B is at "**good**" state and the **non-financial** effect of Asset A is at "**bad**" state.
3. The **financial** return of Asset B is at "**bad**" state and the **non-financial** effect of Asset A is at "**good**" state.
4. The **financial** return of Asset B is at "**bad**" state and the **non-financial** effect of Asset A is at "**bad**" state.

In a few days, you will receive an official PDF that documents the level of CO2 that you prevented.

Your investment in Asset A may still have the non-financial effect of a real CO2 reduction together with the receipt of a certificate documenting the reduction. Based on the information you have just read, what are the exact characteristics that the non-financial effect of your investment in Asset A has? Please choose the correct non-financial implication of your investment.
If you are not sure, please re-read the study information above. You will have two opportunities to get this question correct.

*For every 100 ECU you invest in **Asset A**...*

- ◯ you achieve a CO2 reduction of 25 grams in a good state of the non-financial effect and 25 grams in a bad state of the non-financial effect.
- ◯ you achieve a CO2 reduction of 50 grams in a good state of the non-financial effect and 50 grams in a bad state of the non-financial effect.
- ◯ you achieve a CO2 reduction of 50 grams in a good state of the non-financial effect and 0 grams in a bad state of the non-financial effect.
- ◯ you achieve a CO2 reduction of 0 grams in a good state of the non-financial effect and 50 grams in a bad state of the non-financial effect.

On the next screen, you can make your allocation decision between the two assets by moving a slider. Press “Next Page” to proceed to the next screen.

Part2b - Decision

Investment Decision

Please choose how much you want to invest in Asset A and B.

Asset A Asset B

Asset A	**Asset B**
Financial Return	
Please adjust the slider to see your outcome	Please adjust the slider to see your outcome
Non-financial effect	

Please adjust the slider to see your outcome	Please adjust the slider to see your outcome

Please make your adjustments and click "Next Page" if you are happy with them.

Please answer the following questions:

1. *How important was maximizing the financial return to you when you made your investment decision in Part 2?*

   [0 = not important at all; 10 = very important]

not important very important

0 1 2 3 4 5 6 7 8 9 10

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

2. *When comparing Asset A and Asset B when you made your investment decision in Part 2, how risky did you perceive Asset B compared to Asset A?*

   [0 = not at all; 10 = very risky]

not risky very risky

0 1 2 3 4 5 6 7 8 9 10

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

Social Norms

Please answer the following two questions:

You can earn an additional payment. After the experiment, we will randomly select one of the two actions and we will determine which response was selected by most participants of the experiment. If you give the same response, which was most frequently chosen by other participants, then you will receive an additional £0.50.

Assume that you are presented to a person who has to decide between two actions. Please evaluate each action by ticking an answer.

Action 1 protects the environment for sure, but only to a small extent.

Choosing this action is...

- ◯ very socially inappropriate
- ◯ somewhat socially inappropriate
- ◯ somewhat socially appropriate
- ◯ very socially appropriate

Action 2 protects the environment in a risky way. This means that there is a 50:50 chance of a good state that will protect the environment in the end. If this happens, the environment will be protected to a large extent. However, if a bad state happens, the environment will not be protected at all.

Choosing this action is...

- ◯ very socially inappropriate
- ◯ somewhat socially inappropriate
- ◯ somewhat socially appropriate
- ◯ very socially appropriate

PE Questionnaire

Post-Experimental Questionnaire

In the following, you will find the post-experimental questionnaire. The questionnaire will take about 5 more minutes and we kindly ask you to read the questions carefully and answer truthfully. Please finish this questionnaire, because receiving money for the experiment is bound to the completion of the questionnaire.

After the questionnaire you will receive the results of your investment decision.

Generally speaking, how concerned are you with climate change?

[0 = Not at all concerned; 10 = Very concerned]

Not at all concerned										Very concerned
0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

Do you believe in climate change?

- ○ Yes
- ○ No
- ○ Don't know
- ○ Not applicable / rather not say

Please select from the five answers one answer, which is most likely to apply to you.

In general, when making your investments in the experiment...

- ○ you were happy that you have invested in assets that remove CO2 at all.
- ○ you did not care that you have invested in assets that remove CO2 at all.
- ○ it was most important for you to reach a high level of CO2 removals.
- ○ it was most important for you to reach a low level of CO2 removals.

◯ None of the above applies

Imagine somebody in your friend group asks if anybody has experience with measures to reduce CO2. How likely do you think it is that you would show your friend the CO2 reduction certificate from this experiment?

[0 = very unlikely; 10 = very likely]

very unlikely										very likely
0	1	2	3	4	5	6	7	8	9	10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

How willing are you to take risks, in general?

[0 = completely unwilling to take risks; 10 = completely willing to take risks]

completely unwilling										completely willing
0	1	2	3	4	5	6	7	8	9	10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

How would you assess your personal investment experience?

[0 = not experienced at all; 10 = very experienced]

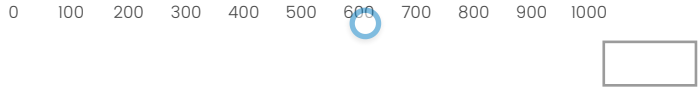
not experienced										very experienced
0	1	2	3	4	5	6	7	8	9	10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

You have ten £1-coins in your pocket. You pass a donation stand that raises money for environmental protection. How many of your coins do you give to the charity?

[£0-£10]

How much money do we have to offer to you today, such that you would give up a sure payment of £1000 that you would get in 6 months?

[Please enter a money amount between £0 and £1000]



How much money do we have to offer to you in 6 months, such that you would give up a sure payment of £1000 that you would get in 12 months?

[Please enter a money amount between £0 and £1000]

Next, we present three possible situations from everyday life and possible reactions to them. Please think about how likely it is that you will behave in the way described. Based on this, please choose your answer.

You and a group of college students worked very hard on a project. Your professor singles you out for a better grade than anyone else.

	not likely 0	1	2	3	4	5	6	7	8	9	very likely 10
You would feel you should not accept it.	○	○	○	○	○	○	○	○	○	○	○

You are driving down the road, and you hit a small animal.

	not likely 0	1	2	3	4	5	6	7	8	9	very likely 10
You'd feel bad you hadn't been more alert driving down the road.	○	○	○	○	○	○	○	○	○	○	○

You make a mistake at your student job and find out a coworker is blamed for the error.

	not likely 0	1	2	3	4	5	6	7	8	9	very likely 10
You would feel unhappy and eager to correct the situation.	○	○	○	○	○	○	○	○	○	○	○

Suppose you had £100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

- ○ More than £102
- ○ Exactly £102
- ○ Less than £102
- ○ Don't know
- ○ Prefer not to say

Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?

- ◯ More than today
- ◯ Exactly the same
- ◯ Less than today
- ◯ Don't know
- ◯ Prefer not to say

Buying a single company's stock usually provides a safer return than a stock mutual fund.

- ◯ True
- ◯ False
- ◯ Don't know
- ◯ Prefer not to say

What is the gender that you identify with?

- ◯ Male
- ◯ Female
- ◯ Diverse
- ◯ Prefer not to say

What is your age in years?

If you are a student, which is your field of study?