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Optimistic framing increases responsible investment of investment professionals

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Abstract: The global warming crisis is unlikely to abate while the world continues to collectively fund the extraction and burning of fossil fuels. Carbon divestment is urgently needed to ward off the impending climate emergency. Yet responsible investments still only account for a modest share of global assets. We conduct an incentivized artefactual field experiment to test whether framing divestment as a social norm, communicating it by a person with perceived credibility and expertise (a messenger), and highlighting optimistic attributes bolster responsible investment. Our subjects are investment professionals who have significant influence over the allocation of funds. We provide evidence that optimistic framing increases responsible investment. Assuming a comparable effect size, the observed increase would represent a \$3.6 trillion USD global shift in asset allocations.

Keywords: experiment, ESG, responsible investment, optimism, framing

JEL codes: C93, G11, G41

Introduction

The accelerating global warming is arguably the most pressing problem that humanity is currently facing. Despite hundreds of world-wide appeals, public protests, and government declarations, the existing initiatives to stop and reverse climate change have proven to be insufficient as scientists keep moving the Doomsday Clock, an estimation for the likelihood of a man-made global catastrophe, closer to midnight.¹ This crisis is unlikely to abate while the world continues to collectively fund the extraction and burning of fossil fuels. Even with some high-profile institutional investors publicly divesting their fossil fuel holdings, the value of global divestments is relatively small.^{2 3} Support for fossil fuel companies continues through funding and subsidies from governments and investment banks.^{4 5 6} A radical change in investment choices is necessary.

Expert commentators warn that only a “massive reallocation of capital” will prevent global warming.⁷ Institutional investors are key to driving this change because of their size and influence. Yet the proportion of responsible investment assets under management globally is only 36 percent.⁸ In addition to reducing the direct funding support for fossil fuel companies, divestment also shifts the public discourse in relation to the legitimacy, reputation, and viability of the industry.^{9 10} Institutional investors play a particularly important role in carbon divestment because investment professionals have the most influence over the proportion of responsible investments. For example, in Europe, the investment market is dominated by institutional investors who as of 2020, account for 72% of all assets under management. Only 28% of assets were related to retail investment.¹¹ Growth in responsible investment, or more precisely, Environmental, Social, and Governance (ESG) oriented investments, is urgently needed to ward off the impending climate emergency. Limiting global warming to 1.5 °C, as per the Paris Climate Agreement, requires a complete net decarbonization of the world’s energy by the middle of this century.¹² Doomsday-type messaging, prevalent in media, does not appear to be shifting carbon divestment enough, despite an increasing number of people declaring their intentions to take action against global warming.¹³ Taking a different approach to diverting investments away from carbon assets is thus paramount. Moving away from doomsday-type messaging could be an avenue to achieving it.

Can framing increase responsible investing?

Previous research has demonstrated that the way information is presented, or “framed,” can lead people to make vastly different decisions for the same choice set.^{14 15 16} Framing is particularly influential in choices involving the evaluation of risk and uncertainty.^{17 18 19} To the best of our knowledge, however, there is no prior (experimental) research on whether framing can motivate responsible investment. The existing research either proposes conjectures which have not been subjected to rigorous testing or only considers a narrow range of messaging frames (i.e., gain versus loss messaging). Furthermore, some research on responsible investing includes private wealth investors but very little extends to institutional investors.^{20 21} In contrast, we apply framing to investment professionals who represent the segment of capital markets with the greatest influence on capital flows. While one may expect experienced

investment professionals to be impervious to framing, there is evidence that professionals can be influenced by framing and make similar judgments as untrained individuals.^{22 23 24}

While a potentially limitless number of frames can be examined, the practical and time constraints of conducting an experiment with investment professionals required us to focus our attention on testing a smaller set of frames based on established theories and evidence. We test the impact of social norm, optimism, and messenger frames, all of which have been shown to shift behavior in other contexts. We conjecture these three frames are likely to influence responsible investment.²⁵

Moving away from carbon assets requires a collective effort that becomes easier to achieve if taking the desired action is perceived to be a social norm.^{26 27 28} Studies on social norms and group dynamics reveal how individuals within a group can develop shared beliefs, values, and behaviors over time, leading to the establishment of social norms that influence individual behavior.^{29 30 31 32} Reducing ambiguity around what the socially appropriate choice is or providing information about other people's behavior can impact decisions.^{33 34} If there exists an underlying social norm, framing is capable of shifting decisions.³⁵ Our social norm frame employs a descriptive norm, i.e., what most people typically do, as distinct from an injunctive norm, i.e., the perception of what is socially permissible. Descriptive norms have been shown to be powerful in shaping behavior. For instance, in a littering study where the amount of litter on the beach was randomly manipulated, researchers found that people were significantly less likely to litter on relatively clean days compared to the heavily littered days. Descriptive norms can influence behavior even in the absence of any explicit injunctions or rules.³⁶

A core feature of investment is uncertainty. When there is uncertainty around future outcomes, some people have a bias for optimism.³⁷ Optimism has also been shown to predict pro-environmental behavior, whereas helplessness acted as a barrier to pro-environmental behavior.^{38 39} A person with an optimistic explanatory style describes bad events as temporary and good events as permanent.⁴⁰ In the Optimism condition, we encourage responsible investment by leveraging the natural bias towards optimism. We test whether highlighting the temporary nature of the pain from divesting and the permanency of the benefits associated with divestment increases responsible investment.

Regarding the messenger frame, decisions, and judgments can sometimes be influenced by persuasion and arguments.⁴¹ A particularly effective technique is using a messenger who carries greater knowledge, experience, or expertise to deliver the content.⁴² Messengers ordained with perceived authority can make a message more persuasive.^{43 44 45} We test whether a carbon divestment statement delivered by a messenger with noted industry experience in finance encourages greater responsible investment.

We test our conjectures in an artefactual online experiment with investment professionals whose decisions are incentivized. The results provide evidence that the optimism frame with an emphasis on the transitory nature of costs and the permanency of future benefits, significantly increases responsible investment by 3.6%. We find the social norm and messenger frames to be ineffective.

Relationship to moral judgments

Responsible investment requires investors to make evaluative judgments that involve a moral component. While our experiment was not specifically designed to test moral judgments about climate action or carbon divestment, findings from moral psychology shed light on factors contributing to insufficient response. Earlier research indicates that a major obstacle to mitigating climate change is that global warming fails to activate moral judgments that lead to action.^{46 47 48} The thinking processes involving moral judgment are typically fast and intuitive and visceral reactions are recognized as an important driver for moral judgment, where individuals have a strong and unexplainable feeling of what is right or wrong.^{49 50 51 52} In contrast to moral judgments about issues such as terrorism or child trafficking, which are more likely to elicit action, responsible investment may not activate a visceral response as a wrong that demands to be righted. Further, there is no explicit moral transgression around responsible investing that requires action because there is no identifiable individual acting intentionally to harm another individual.^{53 54} As a result, actions to mitigate climate change are easily delayed or not undertaken at all, even by individuals who believe climate change is a problem and see the benefits of acting.

Disastrous messaging around climate change does not appear to be shifting carbon divestment enough. There is evidence that it could even be counterproductive. Catastrophic information about the severity of global warming can threaten an individual's beliefs that the world is orderly. Individuals may then defensively respond by disengaging or even dismissing information about global warming to maintain their original position.⁵⁵ Taking a different approach to diverting investments away from carbon assets is thus paramount. We compare and test three communication strategies that could influence the moral judgments of investment professionals around responsible investing which subsequently may also impact their clients' investments.

Experiment

To test whether framing carbon divestment as a social norm, highlighting optimistic attributes, or using a messenger influences the propensity to invest in ESG assets, we conduct an artefactual field experiment in which experienced investment professionals are incentivized to construct their preferred investment portfolios. The decision-making environment is controlled using financial incentives as the expected payoffs directly depend on the subject's allocation decisions in a given scenario.

The four experimental conditions (Control, Social Norm, Optimism, and Messenger; implemented in a between-subjects design) vary only in the framing of a preamble to the investment task. The preambles contain similar information about the impact of climate change on portfolio risk, though their framing highlights different aspects of the message. Table 1 provides a summary of the frames. The full text of all preambles and subject instructions are available in the Supplementary Information.

Our original design included another condition to test the effect of a Loss frame which emphasized the potential losses from not divesting. We were unable to collect the Loss frame data because the conference organizers unintentionally sent the subjects who were randomly selected to be in the Loss frame the link to the Optimism frame. The sample for the Optimism frame became larger as a result. The individual attributes across conditions are distributed similarly because of the individual-level random allocation (see the Supplementary Information for mean attributes such as age and years of experience across conditions).

Table 1. Frames used to motivate responsible investment.

<p>Control</p> <p>The general message highlights the risks of continued investment in fossil fuels: <i>“International financial monitoring bodies warn global warming is now a major financial risk.”</i></p>
<p>Social Norm</p> <p>Presents similar information to the control condition, except that the information is framed as a descriptive norm in financial markets: <i>“Most investors are now realizing that”.</i></p>
<p>Optimism</p> <p>Introduces similar information to the control condition, except that the message contrasts the temporary cost of divestment with more permanent benefits of low carbon emissions over time <i>“In exchange for the temporary pain is a permanent gain”</i> as regulatory disruptions continue to grow.</p>
<p>Messenger</p> <p>The message is delivered by an identifiable person, Bob Litterman, Chairman of the Board of Trustees at Commonfund, who understands <i>“the externalities created by burning fossil fuels... and the desire to position the portfolio to be aligned with his company’s mission.”</i></p>

Investment Task

After reading the information in the condition-specific frame, each participant constructed the preferred investment portfolio for each of the six scenarios with a two-year horizon by allocating a \$100 endowment among four investment options. The four options are: A – conservative investment, B – conservative investment with ESG orientation, C – balanced investment, and D – balanced with ESG orientation. Options B and D are responsible investment options while Options A and C do not have an ESG orientation. The sum of

investments in the four options needed to equal AUD 100. For options that subjects did not want to invest in, they could choose zero. The investment task was identical for every subject.

The six scenarios differ in the following attributes: sustainability charge in the first year, and volatility (Table 2). The different scenarios are systematically constructed to allow further insights into how strengthening moral sentiments of responsible investing affects the trade-off between returns and risks.⁵⁶ The six scenarios also allow for checks on internal consistency (e.g., that lower return/higher risk combinations are not preferred to higher return/lower risk options). To prevent an order effect, the scenarios are ordered randomly for each participant.

Table 2. Information on investment options for the six scenarios in the experiment.

Attributes	Options	Conservative		Balanced	
		A	B	C	D
Environmental, social and government (ESG)	ESG orientation	No	Yes	No	Yes
	Sustainability Charge to in the 1 st year				
	Scenario 1	0%	1.5%	0%	2.25%
	Scenario 2	0%	3%	0%	2.25%
	Scenario 3	0%	3%	0%	4.5%
	Scenario 4	0%	1.5%	0%	2.25%
	Scenario 5	0%	1.5%	0%	2.25%
	Scenario 6	0%	1.5%	0%	2.25%
Performance	Average annual return for the past 3 years	3%	2%	4%	3%
	Expected annual return for the next 10 years	4%	4.5%	6%	6.75%
Volatility	Standard deviation				
	Scenarios 1,2,3	4%	3%	6%	4.5%
	Scenarios 4,5	4%	4.5%	6%	6.75%
	Scenarios 6	4%	4%	6%	6%

The return, volatility, and sustainability charges for the investment options are designed to be consistent with what the subjects encounter in financial markets at the time of the experiment.⁵⁷

^{58 59} Realistic returns and risk numbers are employed across both scenario years. The portfolio return expectations are modeled using a risk-free rate of 0%. The one-off sustainability charge imposed on the ESG options reflects the short-run costs of carbon divestment.

Procedures

The experiment took place during a major industry conference in Australia, on 30 September 2020. The conference was held online because of the Covid pandemic. To avoid priming effects from other sessions of the conference, the experiment was scheduled for the first session. Subjects were randomly assigned to experimental conditions. The experimenters received a list of conference registrants (with registrants' email and phone numbers) from the conference organizers three days before the conference. The experimenters randomized registrants into five conditions (including the Loss condition) with separate experimental condition links using the rand() function in Microsoft Excel. The randomized list, sorted by treatment condition, was sent back to the conference organizers who were responsible for inviting participants by email to participate in the experiment during the conference. At the commencement of the experiment, subjects were sent a condition-specific link to their personal email address and were invited to participate using the link. All conditions were conducted simultaneously. There was no possibility for a subject to participate in more than one condition. Subjects completed the experiment individually and were not permitted to communicate with each other during the experiment to maintain the privacy of their decisions.

To increase the likelihood that subjects read the preamble information before proceeding to the next page, the preamble page was timed so that the 'next' button did not appear until 60 seconds after the page had loaded. After 60 seconds, the instruction to "Please click 'next' only after you've had a chance to read the text thoroughly" appeared. To check that subjects did indeed read the information thoroughly, we measured how long subjects remained on the page. The minimum time was 62 seconds with the average being 110 seconds, i.e., 50 seconds longer than required by design.

Subject instructions specified that the experimenters would randomly select 50 subjects to be paid via bank transfer for their decisions. To prevent potential wealth and portfolio effects, the individual payments depended on the risk and return of one of their chosen investment allocations, randomly selected from the six scenarios. Since each of the six scenarios had an equal chance of being chosen and the participants did not know in advance which would be chosen, they were explicitly asked to think about each portfolio carefully. To determine the payment for the drawn portfolio, the two-year return from the selected \$100 portfolio allocation was calculated using the corresponding attributes. Options B and D with an ESG orientation incurred an initial sustainability charge applied to the first year only; there was no charge in the second year. If a subject selected one or both of these options, the charge was forwarded on his/her behalf to the Natural Resources Defense Council which is a charity working to safeguard the Earth - its people, its plants and animals, and the natural systems. At the end of the experiment, subjects filled out a questionnaire that included items from the Revised Life Orientation Test to measure subjects' personal orientation towards optimism.⁶⁰

Subjects selected for payment were contacted via email to obtain their bank account details and the payment was made via bank transfer. A replacement was drawn if a subject did not respond to the payment email within two days. All the above information was common knowledge. The average payment for the 50 paid subjects was AUD 107.80.

In total, 468 experienced investment professionals, such as portfolio managers, financial planners, service providers, and executives participated in the study. Using investment professionals as subjects provides for a rigorous test of our conjectures in the sense the subjects are sophisticated investors who are trained to make calculated judgments based on market indicators and as such should be less susceptible to framing. Equally importantly, the professional subject pool increases the external validity of our findings with respect to formulating policy recommendations because investment professionals overseeing portfolio investment allocations have significant influence over ESG-oriented investments. From an economic point of view, investment professionals have significant influence over the allocation of funds to responsible investments, which can act as leverage of the observed effects.

The experimental protocol was approved by the Human Research Ethics Committee at Macquarie University, Australia. Informed consent was obtained from all subjects and the experiment was performed in accordance with the guidelines and regulations set out by the ethics committee. The experiment was programmed in Lime Survey software.

Results

We excluded 133 subjects (29 in Control, 32 in Social Norm, 56 in Optimism, and 16 in the Messenger condition) who completed the experiment but had no intention of increasing their investment in ESG within the next 10 years, or who identified as support-service providers not overseeing investment decisions because they were not in our target population. The analyzed sample size for the experiment was 335 investment professionals, 76% of whom were males. Note that individuals in our sample may be considering increasing their ESG investments because it aligns with their values but could also be purely profit-driven and expect relatively higher returns from ESG investments.

We first compare the average ESG allocations across the four conditions that we collected data for. Our results show that the Optimism condition yields the highest average ESG allocation (Table 3, Panel A). Then to understand how a person's level of optimism may interact with our implemented framing of responsible investing we decompose the results by optimistic life orientation (Table 3, Panel B). We find that optimistic investment professionals respond to optimistic framing. We then compare ESG Conservative and ESG Balanced allocations separately and observe greater framing effects in balanced options. Regarding the question of how framing impacts the trade-offs between volatility and returns, we observe that greater marginal volatility has little effect on average ESG allocations whereas one-off sustainability charges were negatively associated with average ESG allocations.

The Optimism frame produces the highest ESG allocations on average

The ESG allocations (in %) across our four conditions are reported in Table 3, Panel A. The Optimism condition yields the highest average ESG allocation (67.87%) followed by the Messenger (64.71%), Control (64.24%), and Social Norm (63.56%) conditions. The difference in ESG allocations between the Optimism condition and the Control condition is statistically

significant using a one-sided t -test, ($p=0.026$), while there is no statistically significant difference between the Social Norm or Messenger conditions and the Control condition ($p=0.391$ and $p=0.415$, respectively). The effect size as measured by Cohen's d is 0.11.

Table 3: Average ESG Investment across all six scenarios.

	Control	Social Norm	Optimism	Messenger
Panel A: All subjects				
% ESG Investment [options B and D] (Standard deviation)	64.24 (32.81)	63.56 (36.45)	67.87 (33.01)	64.71 (31.44)
Total observations (subjects) = 2010 (335)	516 (86)	336 (56)	786 (131)	372 (62)
One-sided t -test (Column condition vs Control)	--	$t = 0.276$ $p = 0.391$	$t = -1.949$ $p = 0.026$	$t = -0.215$ $p = 0.415$
Panel B: Subjects with a more optimistic life orientation				
% ESG Investment (options B and D) (Standard deviation)	63.04 (33.18)	60.80 (37.56)	73.53 (31.96)	67.96 (30.90)
Total observations (subjects) = 1356 (226)	348 (58)	240 (40)	486 (81)	282 (47)
One-sided t -test (Column condition vs Control)	--	$t = -0.745$ $p = 0.228$	$t = -4.572$ $p < 0.001$	$t = -1.922$ $p = 0.028$
Panel C: Conservative ESG Allocations				
Mean Investment (Standard deviation)	20.50 (23.36)	18.34 (21.21)	17.91 (22.55)	17.93 (20.55)
Total observations (subjects) = 2010 (335) subjects	516 (86)	336 (56)	786 (131)	372 (62)
One-sided t -test (Column condition vs Control)	--	$t = 1.395$ $p = 0.082$	$t = 1.983$ $p = 0.024$	$t = 1.715$ $p = 0.043$
Panel D: Balanced ESG Allocations				
Mean Investment (Standard deviation)	43.74 (31.92)	45.23 (34.91)	49.97 (34.41)	46.78 (32.88)
Total observations (subjects) = 2010 (335)	516 (86)	336 (56)	786 (131)	372 (62)
One-sided t -test (Column condition vs Control)	--	$t = -0.626$ $p = 0.266$	$t = -3.335$ $p < 0.001$	$t = -1.374$ $p = 0.085$

Notes: (i) Standard deviations were calculated using all observations. (ii) As a robustness check, we repeat the analysis in Panel A to include individuals who had no intention of increasing their investment in ESG within the next 10 years. The p-values are: Control vs Social Norm ($p=0.419$); Control vs Messenger ($p=0.495$); and Control vs Optimism ($p=0.146$). The increased p-values support our expectations that individuals with no intention of increasing their ESG investments in the next 10 years would be impervious to framing.

To ensure the larger sample size of the Optimism condition is not responsible for the statistical significance, we conduct a robustness check. After randomly reducing the Optimism condition sample by 50 percent to be comparable in size to the other conditions, the difference is still statistically significant using a one-sided t -test ($p=0.041$). The result confirms that under the optimistic frame investment professionals allocate more capital to ESG options.

Optimistic investment professionals respond to optimistic framing

In our examination of the relationship between optimism and the implemented frames (see Table 3, Panel B), we restrict our samples to the investors who scored average or above (11 or more out of 15; henceforth “more optimistic”) in the Revised Life Orientation Test items.⁵⁴ When we compare more optimistic investors across conditions, those in the Optimism condition invested 10 percentage points more compared with the Control condition. The difference is statistically significant using a one-sided t -test ($p<0.001$; Cohen’s $d =0.32$), providing evidence that more optimistic investors do positively respond to an optimistically framed message about portfolio risk stemming from climate change. These results are further confirmed with a random effects panel regression, with robust errors clustered at the individual level. Regression output is provided in the Supplementary Information. We also find a positive effect of the Messenger framing on more optimistic investors ($p=0.028$), but a statistically insignificant effect of the Social Norm framing ($p=0.228$).

We compare whether more optimistic investors respond to our respective frames more strongly than less optimistic investors. Of particular interest is the response to optimistic framing. We find that more optimistic investors allocated approximately 15 percentage points more on average (73.53%) than less optimistic investors in the Optimism condition (58.70%). The difference is statistically significant using a one-sided t -test ($p<0.001$; Cohen’s $d =0.46$).

A greater response from more optimistic investors was also observed in the Messenger condition. More optimistic investors allocated significantly more 67.96% on average compared to 54.52% by less optimistic investors ($p<0.001$ one-sided t -test; Cohen’s $d =0.29$). In the Social Norm condition, more optimistic investors allocated 60.80% on average, while less optimistic investors allocated significantly more 70.47%, using a one-sided t -test ($p=0.010$; Cohen’s $d=0.27$).

To evaluate whether optimists choose a higher ESG allocation in general, we compare the average allocation of more optimistic investors (63.04%) and less optimistic investors (66.72%) in the Control condition. The difference is not statistically significant using a one-sided t -test ($p=0.113$), implying that the changes in investment behavior are driven by the respective frames rather than by the more/less optimistic life orientation.

Framing more effective with balanced allocations

We compare ESG Conservative and ESG Balanced allocations separately to observe whether the framing effects differ between conservative and balanced options (see Table 3, Panels C

and D). For balanced allocations, as with the combined ESG allocations, the Optimism condition yields significantly higher ESG allocations (49.97) compared to the Control condition (43.74). The result is significant using a one-sided *t*-test ($p < 0.001$; Cohen's $d = 0.30$). The increase corresponds to a smaller, yet significant ($p = 0.024$; Cohen's $d = 0.11$) decrease in responsible investment in the conservative ESG option for the Optimism condition compared to the Control condition. Similar effects are observed across the remaining conditions indicating that framing may encourage greater risk tolerance for responsible investment. Framing is therefore likely to be more effective in encouraging responsible investment with non-defensive assets.

Investment professionals are sophisticated in their decision making

A common behavioral strategy enacted by investors is the diversification heuristic.⁶¹ When investors are confused by the available choices, they sometimes adopt a naïve approach to diversification by simply spreading their investments evenly across the available choices. There were only 151 (5.4%) naively diversified portfolios out of 2,808 portfolios in total across all conditions (see Fig. S3 in the Supplementary Information). This observation provides further evidence of the level of sophistication the investment professionals applied while participating in the experiment.

One-off sustainability charges negatively impact ESG allocations

Figure 1 shows the ESG allocations across the six scenarios for each of the four conditions. The portfolio with the highest sustainability charges (Portfolio 3) has the lowest percentage of ESG invested across all conditions. The higher ESG allocation in Scenario 1 compared to Scenario 3 can be attributed to the lower ESG charge in Scenario 1 of 1.5% for the Conservative option and 2.25% for the Balanced option compared to the higher ESG charge of 3% and 4.5% in Scenario 3. The difference suggests an average 12.06% increase in preference for responsible investments in response to an average 1.7% fall in the cost of responsible investing. However, sensitivity varies across conditions. The Norms and Messenger conditions had less sensitivity than the Control and Optimism conditions.

Higher marginal volatility does not negatively affect ESG allocations

We observe little impact of marginal increases in volatility risk on ESG allocations. Scenario 4 has higher volatility (standard deviation) for the ESG options than Scenario 6. The contrast between these scenarios therefore measures the impact that volatility has on ESG investment choices. Figure 1 shows the proportion allocated to ESG investments is slightly higher for Scenario 6 compared to Scenario 4 across the four conditions. If subjects were sensitive to the greater volatility risk associated with ESG we would observe substantially lower ESG investment in Scenario 4 compared to Scenario 6 and this is not the case. Investment professionals therefore appear to be insensitive to marginal increases in volatility risk when

considering ESG allocations. One caveat is that differences in volatility among the six scenarios are modest and may not hold when dramatically different as might arise in highly volatile conditions.

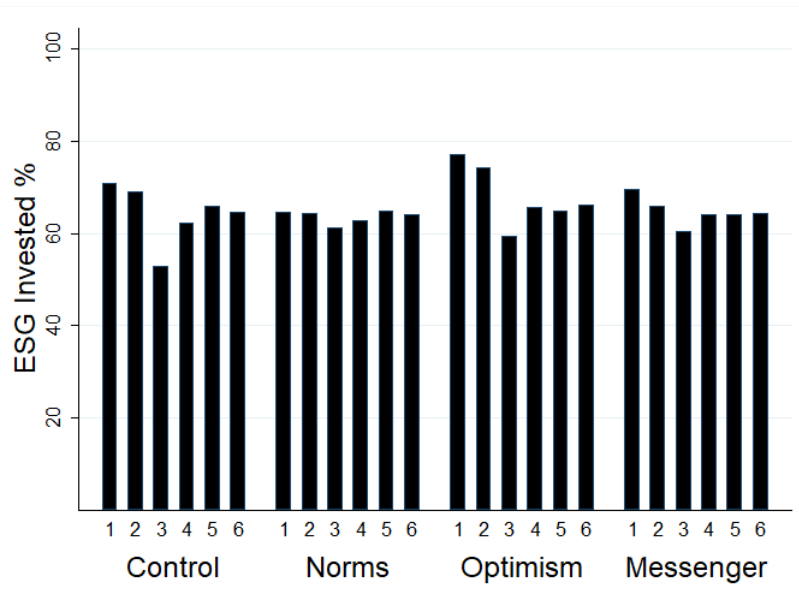


Figure 1: ESG (%) allocation for scenarios (1-6) by condition. The higher sustainability charge in Scenario 3 is associated with lower ESG investment. Note: $N=335$ subjects.

Discussion

The world is facing a climate crisis and innovative solutions are needed. Shifting capital away from fossil fuel industries and towards responsible investing is a key part of the solution. One major challenge for responsible investing is that it requires making evaluative judgments with a moral component. However, it appears that global warming fails to activate moral judgments that would lead to collective action.^{46,62} In this article we report insights from an incentivized online experiment with investment professionals that point towards an effective communication strategy to increase responsible investment. The analyzed sample consists of individuals who stated their intention to increase their investment in ESG within the next 10 years and who are thus likely to be receptive to messages about climate change. We demonstrate that framing divestment decisions in a more optimistic orientation, with an emphasis on the transitory nature of costs and the permanency of future benefits, significantly increases responsible investment by 3.6%. With total professionally managed assets valued at USD \$98.4 trillion globally, a comparable effect size would represent a USD \$3.6 trillion shift in asset allocations.⁸

The presented experiment paves the way for future exploration of the mechanisms to foster greater engagement in responsible investing. Future research is necessary with respect to identifying the specific vehicles investment experts prefer for responsible investing and the appropriate methods for communicating the outcomes of responsible investments. The findings

from our experiment contribute to understanding how the analytical facets of responsible investing could be enhanced by reframing the urgency of carbon divestment from doomsday to optimism.

Data availability

Data is available in the Supplementary Information.

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Author contributions

D.K. and D.D. contributed to the study design, analyzed the results, and wrote the manuscript. M.S. and L.Z. contributed to the study design, collected the data, and wrote the manuscript.

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Competing interests

The authors declare no competing interests.

Additional information

Experimental instructions, procedures, further data analysis, and STATA code are available in the Supplementary Information.

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Supplementary Information: Optimistic framing increases responsible investment of investment professionals

Content:

- A. Experiment Instructions
- B. Ethics Approval
- C. Attributes (mean values) across conditions
- D. Further Details on Experimental Procedures
- E. Further Data Analysis
- F. STATA Code

.....

A. Experiment Instructions

Portfolio Choice Task

Please **do not start** until instructed. Instructions will be provided at 9:55am

Welcome!

Participating in this online task **contributes to your CE/CPD accreditation**, as proof of attendance at this session.

It should take approximately 20 minutes to complete.

You will be asked to read information about investment strategies and then allocate \$100 between four investment options to create your most preferred portfolio.

In total, there will be six investment scenarios with different parameters, and you will create a portfolio for each of them.

After you have made your choices, a short questionnaire will follow.

Your choices are anonymous. Please do not share or discuss them with anyone during the experiment.

There are 24 questions in this survey.

Payment

We will randomly select 50 participants who will get paid for their decisions today. The payment will depend on the risk and return of one of your six investment portfolios.

The portfolio that is paid will be randomly selected out of the six. If you are selected for payment, we will contact you via email to obtain your bank account details and the payment will be made via bank transfer.

To determine your payment, we will calculate the return on an investment from your \$100 portfolio.

Before we proceed to constructing portfolios, please read the following information relevant to the task. Further details about the portfolio construction task will be provided after this information.

Participant Consent

You are invited to participate in a study of economic decision making. The purpose of the experiment is to investigate how people make decisions in the environment described in the instructions.

Principal investigators: Dr Danielle Kent, Professor Maroš Servátka, Dr Lyla Zhang

If you decide to participate, the experiment will take approximately 20 minutes.

Any information or personal details gathered in the course of the study are confidential, except as required by law. Only the researchers will have access to the data and no individual will be identified in any publication of the results.

Participation in this study is entirely voluntary: you are not obliged to participate and if you decide to participate, you are free to withdraw at any time without having to give a reason and without consequence.

I have read and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence.

Yes *

Please choose **only one** of the following:

- Yes
 - No
-

Payment Details

In order to facilitate the payment, please provide your mobile number and email address. The contact details you provide here will be used for the purposes of this experiment only.

What is your mobile phone number? *

What is your work email address? *

How the returns are calculated

To determine the payment for the drawn portfolio, we will calculate the return on an investment from your \$100 portfolio for **two years** using the corresponding attributes. (You can think of each day of the conference representing one year.)

After you have made your decisions, there will not be any further opportunities to change your portfolios, that is your portfolios will remain identical for 2 years. Note that there is no inflation in this experiment and the risk-free rate is 0%.

Options B and D with an ESG orientation will incur an initial sustainability charge that will be applied to the **first year only**, and not the second year. If you select one or both of these options, the charge will be forwarded on your behalf to the Natural Resources Defence Council who are a charity working to safeguard the Earth - its people, its plants and animals, and the natural systems. (You can think of the ESG charge as your donation to this charity generated by your portfolio.) We will forward you the joint contribution receipt as part of the follow up survey after the conference.

[CONTROL Treatment]

Please read the following IMPORTANT information regarding the experiment

International financial monitoring bodies warn global warming is now a major financial risk. There would be impact on global portfolio holdings if appropriate incentives to reduce greenhouse gas emissions were instituted worldwide.

High carbon emission assets would become less valuable and the valuations of companies holding those assets would fall. As expectations of such policies being implemented grow, there is a greater risk of fossil fuel assets becoming stranded assets.

While the absolute size of those stranded assets in some investment portfolios may be small, there are tiny holdings of stranded assets in many portfolios, making it difficult and expensive to arrange to sell all those assets.

The investor's decision therefore needs to consider the management of portfolio risk in the face of our understanding of the reality of the externalities created by burning fossil fuels, the likelihood that stranded assets would underperform, and the desire to position aligned portfolios with the investor's mission.

Please take as much time as you need. You will be able to proceed to the next step after 60 seconds.

Please note that you can still take more time to read the provided information. Please click "next" only after you've had a chance to read the text thoroughly.

[SOCIAL NORM Condition]

Please read the following IMPORTANT information regarding the experiment

International financial monitoring bodies warn global warming is now a major financial risk. There would be impact on global portfolio holdings if appropriate incentives to reduce greenhouse gas emissions were instituted worldwide.

Most investors are now realising that high carbon emission assets would become less valuable and the valuations of companies holding those assets would fall. As expectations of such policies being implemented grow, there is a greater risk of fossil fuel assets becoming stranded assets.

While the absolute size of those stranded assets in some investment portfolios may be small, there are tiny holdings of stranded assets in many portfolios, making it difficult and expensive to arrange to sell all those assets at the same time as everyone else.

The investor's decision therefore needs to consider the management of portfolio risk in the face of our understanding of the reality of the externalities created by burning fossil fuels, the likelihood that stranded assets would underperform, and the desire to position aligned portfolios with the investor's mission.

Please take as much time as you need. You will be able to proceed to the next step after 60 seconds.

Please note that you can still take more time to read the provided information. Please click "next" only after you've had a chance to read the text thoroughly.

[OPTIMISM Condition]

Please read the following IMPORTANT information regarding the experiment

International financial monitoring bodies warn global warming is now a major financial risk. There would be impact on global portfolio holdings if appropriate incentives to reduce greenhouse gas emissions were instituted worldwide.

Reducing portfolio holdings away from high carbon emission assets can be temporarily challenging. Because while the absolute size of those stranded assets in some portfolios may be small, there are tiny holdings of stranded assets in many of the portfolios, making it difficult and expensive to arrange to sell all those assets.

In exchange for the temporary pain is a permanent gain in returns going forward. Low carbon emission assets will become more valuable over time and the valuations of companies holding those assets will continue to rise. Because, as expectations of greenhouse gas regulatory disruptions continue to grow, there will be ongoing and growing likelihood of fossil fuel assets becoming stranded assets.

The investor's decision therefore needs to consider the management of portfolio risk in the face of our understanding of the reality of the externalities created by burning fossil fuels, the likelihood that stranded assets would underperform, and the desire to position aligned portfolios with the investor's mission.

Please take as much time as you need. You will be able to proceed to the next step after 60 seconds.

Please note that you can still take more time to read the provided information. Please click "next" only after you've had a chance to read the text thoroughly.

[MESSENGER Condition]

Please read the following IMPORTANT information regarding the experiment

International financial monitoring bodies warn global warming is now a major financial risk. There would be impact on global portfolio holdings if appropriate incentives to reduce greenhouse gas emissions were instituted worldwide.

Two years ago Bob Litterman, Chairman of the Board of Trustees at Commonfund, asked himself what the impact on their portfolio holdings would be if appropriate incentives to reduce greenhouse gas emissions were instituted globally. The answer was obvious – high carbon emission assets would become less valuable and there would be a greater risk of fossil fuel assets becoming stranded assets.

He and his astute portfolio managers anticipated that as expectations of such policies being implemented grew, it would negatively impact the valuations of stranded assets. And while the absolute size of those stranded assets in his portfolio was small, there were tiny holdings of stranded assets in many of the portfolios that they invested in, making it difficult and expensive to arrange to sell all those assets.

In order to reduce the expense and complexity of selling those assets Bob Litterman decided to create the equivalent economic exposure by entering into an innovative financial instrument, a “stranded asset total return swap.” The swap was a very simple contract between two counterparties, in this case with Deutsche Bank. Every three months one party pays the other depending on whether stranded assets have outperformed or underperformed the market. Bob Litterman therefore protected Commonfund portfolio against the risk created by these “stranded assets.” It was a decision based on managing portfolio risk in the face of Bob and his portfolio managers’ understanding of the reality of the externalities created by burning fossil fuels, the likelihood that stranded assets would underperform, and the desire to position the portfolio to be aligned with his company’s mission.

Please take as much time as you need. You will be able to proceed to the next step after 60 seconds.

Please note that you can still take more time to read the provided information. Please click "next" only after you've had a chance to read the text thoroughly.

Constructing Six Portfolios

In the decision task that follows, you will be presented with six scenarios, one at a time. The scenarios were generated for this task and are not meant to reflect the existing market conditions.

For each of the scenarios you will construct your most preferred portfolio by allocating \$100 among the four investment options, A, B, C, and D. Some of the attributes of these four options might differ between scenarios.

You will create your portfolio by indicating the amount you would like to put on each option.

The sum of investments into the four options **must be equal to \$100**.

Please **choose 0** for options you do not want to invest in.

Please note that each of the six scenarios has an equal chance of being chosen and you do not know in advance which will be chosen, so think about each portfolio carefully.

Attributes		Conservative		Balanced	
		A	B	C	D
Environmental, social and government (ESG)	ESG orientation	No	Yes	No	Yes
	Sustainability Charge to You in the 1 st year	0%	1.5%	0%	2.25%
Performance	Average annual return for the past 3 years	3%	2%	4%	3%
	Expected annual return for the next 10 years	4%	4.5%	6%	6.75%
Volatility	Standard deviation	4%	3%	6%	4.5%

*Please ensure the total is 100

	A	B	C	D
Allocation				

Please **choose 0** for options you do not want to invest in.

Attributes		Conservative		Balanced	
		A	B	C	D
Environmental, social and government (ESG)	ESG orientation	No	Yes	No	Yes
	Sustainability Charge to You in the 1 st year	0%	3%	0%	2.25%
Performance	Average annual return for the past 3 years	3%	2%	4%	3%
	Expected annual return for the next 10 years	4%	4.5%	6%	6.75%
Volatility	Standard deviation	4%	3%	6%	4.5%

*Please ensure the total is 100

	A	B	C	D
Allocation				

Please **choose 0** for options you do not want to invest in.

Attributes		Conservative		Balanced	
		A	B	C	D
Environmental, social and government (ESG)	ESG orientation	No	Yes	No	Yes
	Sustainability Charge to You in the 1 st year	0%	3%	0%	4.5%
Performance	Average annual return for the past 3 years	3%	2%	4%	3%
	Expected annual return for the next 10 years	4%	4.5%	6%	6.75%
Volatility	Standard deviation	4%	3%	6%	4.5%

*Please ensure the total is 100

	A	B	C	D
Allocation				

Please **choose 0** for options you do not want to invest in.

Attributes		Conservative		Balanced	
		A	B	C	D
Environmental, social and government (ESG)	ESG orientation	No	Yes	No	Yes
	Sustainability Charge to You in the 1 st year	0%	1.5%	0%	2.25%
Performance	Average annual return for the past 3 years	3%	2%	4%	3%
	Expected annual return for the next 10 years	4%	4.5%	6%	6.75%
Volatility	Standard deviation	4%	4.5%	6%	6.75%

* Please ensure the total is 100

	A	B	C	D
Allocation				

Please **choose 0** for options you do not want to invest in.

Attributes		Conservative		Balanced	
		A	B	C	D
Environmental, social and government (ESG)	ESG orientation	No	Yes	No	Yes
	Sustainability Charge to You in the 1 st year	0%	1.5%	0%	2.25%
Performance	Average annual return for the past 3 years	3%	2%	4%	3%
	Expected annual return for the next 10 years	4%	4.5%	6%	6.75%
Volatility	Standard deviation	4%	4%	6%	6.75%

*Please ensure the total is 100

	A	B	C	D
Allocation				

Please **choose 0** for options you do not want to invest in.

Attributes		Conservative		Balanced	
		A	B	C	D
Environmental, social and government (ESG)	ESG orientation	No	Yes	No	Yes
	Sustainability Charge to You in the 1 st year	0%	1.5%	0%	2.25%
Performance	Average annual return for the past 3 years	3%	2%	4%	3%
	Expected annual return for the next 10 years	4%	4.5%	6%	6.75%
Volatility	Standard deviation	4%	4%	6%	6%

*Please ensure the total is 100

	A	B	C	D
Allocation				

Please **choose 0** for options you do not want to invest in.

Demographics

Which type of organizations do you work for? *

Choose one of the following answers

Please choose **only one** of the following:

- FP = Financial Planning
- FP-FO = Financial Planning / Family Office
- PI = Private Investor
- SP-ASSOC = Service Provider/ Association
- SP-CO = Service Provider/ Consulting
- SP-ED = Service Provider/ Education
- SP-FM = Service Provider/ Funds Management
- SP-FM-MTM = Service Provider/ Funds Management (Multi-manager)
- SP-MKTG = Service Provider/ Marketing/PR
- SP-PLAT = Service Provider/ Trading platform
- SP-RSH = Service Provider/ Research House / Investment Consulting House
- SP-SF = Service Provider/ Super Fund
- SP-TRUSTCO = Service Provider/ Trust Company
- Other

What is your job position? *

Please choose....

v

- BUS = Business / Operational role
- P = Principal of the firm
- FP = Financial adviser
- PP = Paraplanner
- RSH = Research analyst
- IC = Investment Consultant
- ED = Teacher/Lecturer
- EXEC = C suite level
- S&M = Sales & Marketing
- INV = Investment role
- Other

Are you an Advocate or Practitioner?

*Please choose **only one** of the following:

- An Advocate (Advocates champion specific funds to Practitioners for use in portfolios.)
- A Practitioner (Practitioners have some influence over whether a fund is used or not.)
- Neither

What is your gender? *

Please choose **only one** of the following:

- Male
- Female
- Prefer not to answer

What was your age at your last birthday? *

*Only numbers may be entered in this field.

How long have you been working in the Finance industry? *

*Only numbers may be entered in this field.

This includes the time in different roles.

Please indicate the extent you agree with each of the following statements.

[1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree]

*

Please choose the appropriate response for each item:

	1	2	3	4	5
In uncertain times, I usually expect the best					
I'm always optimistic about my future					
I hardly ever expect things to go my way					

Please indicate the extent you agree with each of the following statements.

[1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree]

*Please choose the appropriate response for each item:

	1	2	3	4	5
I expect the price of ESG investments to increase over time					
The environment is important to me					
I put a lot of thought into my investment decisions					
The regulatory risk of high carbon emission assets is high					
The regulatory risk of high carbon emission assets will increase					

In the near future, I plan to increase the share of ESG investments in my personal portfolio.

*Check all that apply

- In a month
- In a year
- In 10 years
- I do not plan to increase my share of ESG investments

Was the amount of money offered enough for you to take the task seriously? *

- Yes
- No

What motivated your choices in the experiment?

Is there anything else you want to tell us?

Submit

—
Thanks for participating! Your participation is noted.

The overall results of this task will be presented on the second day of the Forum.

B. Ethics Approval

Informed consent was obtained from all participants and the experiment was performed in accordance with Macquarie University Human Research Ethics Committee approval. ref. # 5201700434

C. Attributes (Mean values) across conditions

Variable	Control	Norms	Optimism	Messenger
LOT-R items average score	11.28	11.03	11.01	11.28
Average Age (years)	43.44	44.16	43.11	44.10
Prop of Females	0.27	0.26	0.19	0.37
Years of Experience	19.14	18.80	18.61	17.96

Table S1: Mean values of attributes across conditions.

D. Further Details on Experimental Procedures

The experiment was conducted online on September 30, 2020 as part of a portfolio Markets Summit, a continuing education event organized by the Portfolio Construction Forum (PCF) with a live hybrid program with delegates from across Australia and New Zealand. PCF is a specialist and independent investment continuing education body and accreditation and certification service. PCF provides a curriculum curated for the community of wealth management professionals. Participants who registered for this conference were finance professionals such as portfolio managers, financial planners, service providers, and executives.

Randomization

The experimenters received a list of conference registrants (with registrants' email and phone numbers) from the conference organizers 3 days before the conference. The experimenters randomized registrants into five conditions with separate experimental condition links using the *rand()* function in Microsoft Excel. The randomized list, sorted by condition, was sent back to the conference organizers who were responsible for inviting participants by email to participate in the experiment during the conference.

The experiment

To avoid potential priming and confounding effects stemming from the conference program, the experiment took place in the first session of the conference. Participants were sent a condition-specific link to their personal email address that they used to register for the conference. The decisions were

elicited using the Lime Survey platform. The platform only allowed one submission from a single IP address and submissions were closed at the conclusion of the experiment.

Participants were asked not to share or discuss them with anyone during the experiment. They were also instructed that the experimenters would randomly select 50 participants to get paid for their decisions. The payment depended on the risk and return of one of their six investment portfolios. The portfolio that was paid, was randomly selected out of the six. Since each of the six scenarios had an equal chance of being chosen and the participants did not know in advance which would be chosen, they were explicitly asked to think about each portfolio carefully.

To determine the payment for the drawn portfolio, the two-year return from the selected \$100 portfolio allocation was calculated using the corresponding attributes. Options B and D with an ESG orientation incurred an initial sustainability charge applied to the first year only; there was no charge in the second year. If a participant selected one or both of these options, the charge was forwarded on his/her behalf to the Natural Resources Defense Council who are a charity working to safeguard the Earth - its people, its plants and animals, and the natural systems. All participants selected for payment were forwarded the joint contribution receipt. After the investment task, participants filled out a three-item survey extracted from the Revised Life Orientation Test to measure the respondent's level of optimism followed by a demographic questionnaire.⁶²

Participants selected for payment were contacted via email to obtain their bank account details and the payment was made via bank transfer. A replacement was drawn if a participant did not respond to the payment email within two days. All the above information was common knowledge.

Our final sample consists of 335 individuals: 76 percent males, 22 percent females and 2 percent identifying as other. The average age of individuals in our final sample was 44 years old, with an average of 18.34 years of experience. There were 424 participants who completed the experiment. We excluded 89 individuals who had no intention of increasing their investment in ESG within the next 10 years, or who identified as support-service providers that did not oversee investment decisions because they were not in our target population. 50 participants were randomly selected for payment, with an average payment of AUD \$107.80.

Options and returns were based on typical market conservative and balanced options. Asset allocations for typical conservative and balanced options are demonstrated by Blackrock's Product Disclosure Statement⁶². The conservative investment option contains large exposures to less volatile asset classes such as fixed income and cash. In contrast, the balanced investment option holds greater allocations to the growth-oriented asset classes such as Australian and international equities. Investors typically select one option or a combination of the two depending on their risk attitudes and their expectation about future returns.

The identifiable person used as the messenger in the Messenger frame is Robert Litterman, Chairman of the Board of Trustees at Commonfund. His public position on climate change was used in our Messenger framing.

E. Further Analysis

Fig. S1 shows that the Optimism frame resulted in a 4-percentage point higher ESG allocation compared to the Control condition.

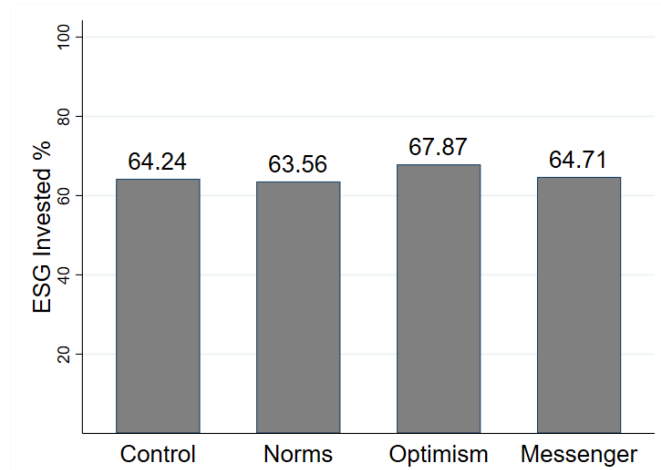


Fig. S1: ESG (%) allocation of finance professionals who intended to increase their investments in ESG in the future (responding either in a month, year or in 10 years) in each condition.

Notes: N=335 subjects; Control=86; Norms=56; Optimism=131; Messenger =62.

Effect Size: Cohen's d 0.11 (Control versus Optimism Condition)

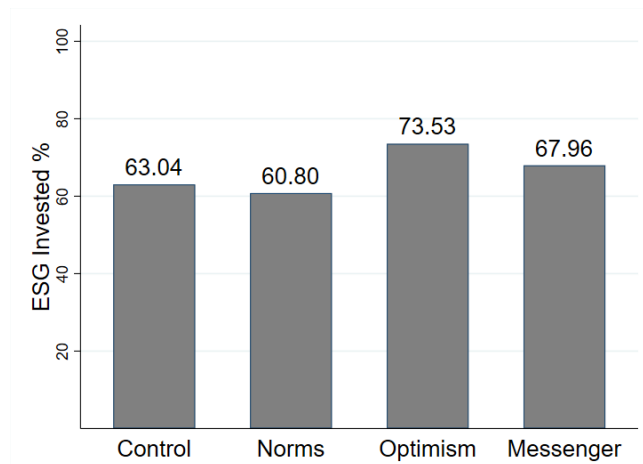


Fig. S2: ESG (%) allocated by investment professionals who had a more optimistic life orientation. Notes: N=226 subjects, Control=58; Norms=40; Optimism=81; Messenger =47.

Effect Size: Cohen's d 0.32 (Optimists in Control versus Optimists in Optimism Condition)

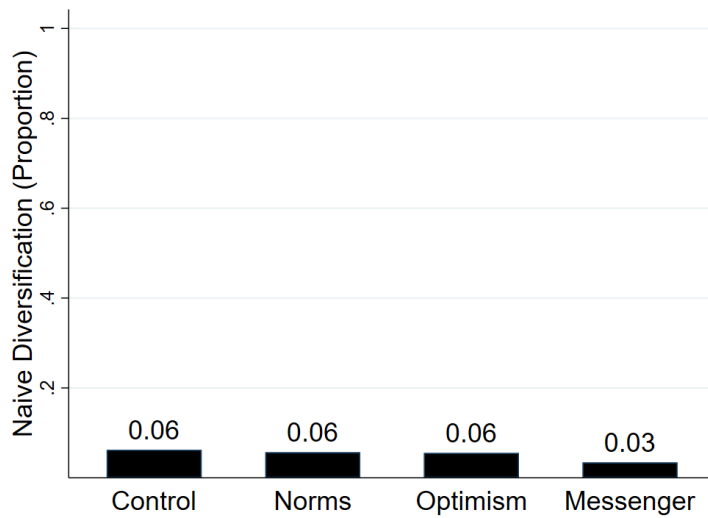


Fig. S3: Proportion of naively diversified portfolios by condition. Notes: 151 portfolios naively diversified across all conditions from a total of 2,808 portfolio allocations.

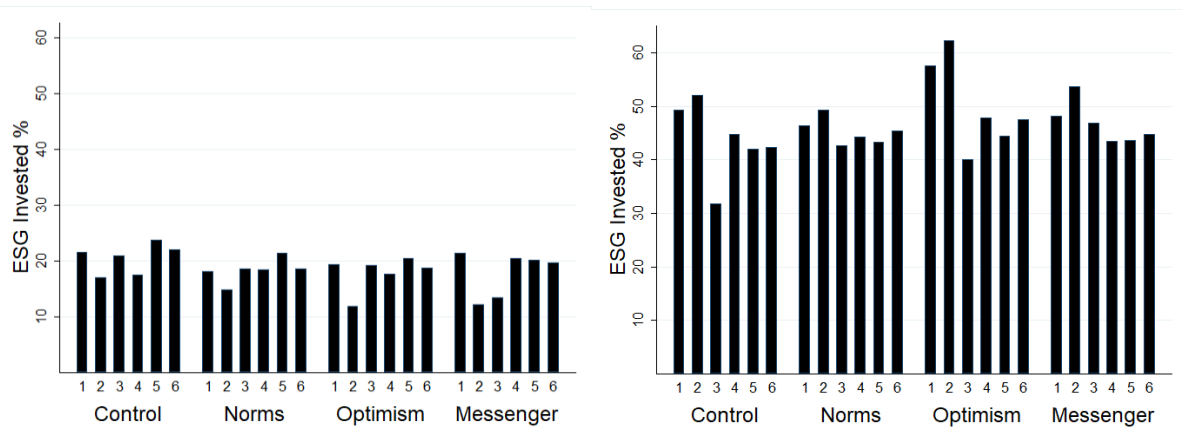


Fig. S4. Conservative ESG (%) allocation (left panel) and Balanced ESG (%) allocation (right panel) for Scenarios 1-6 by condition. These panels illustrate that investors are rebalancing the overall portfolio risk. This is most apparent by comparing the Conservative allocations with the Balance allocations for Scenarios 4, 5 and 6. Note the risk on the Conservative ESG option decreases between Scenarios 4 and 5. If we ignore any trade-off between risk and sustainability, we would expect to see a rebalancing towards the Conservative options from the Balanced options. This shift can be observed across four of the conditions (i.e., Control, Norms and Optimism). In a similar way, note the risk on the Balanced ESG option decreases between Scenario 5 and 6. Aside from risk versus sustainability preferences, a rebalancing towards Balanced from Conservative options should occur. We see this anticipated shift across all five conditions.

Post Experiment Questionnaire responses

After participants made their portfolio allocation choices, there were several questions to measure optimism, attitudes, expectations, and intentions around responsible investment.

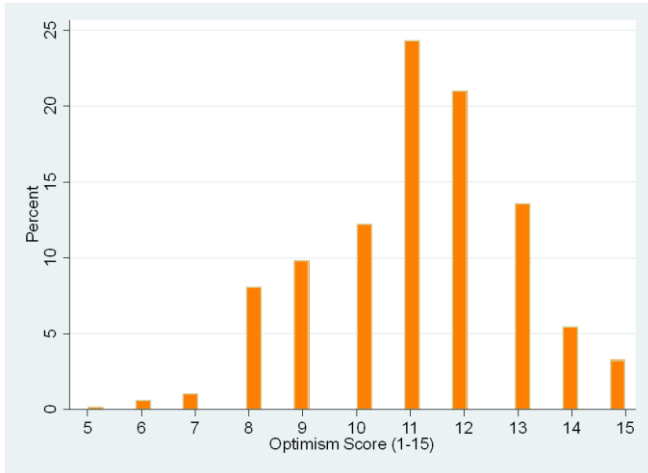


Fig S5. Distribution of total score of Life Orientation (LOT-R) Items

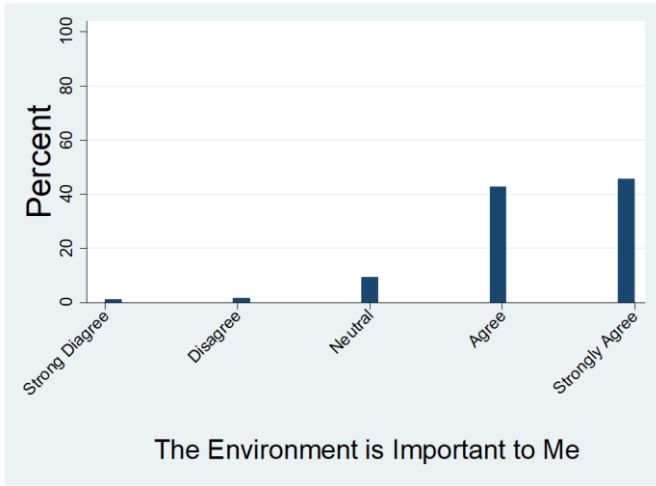


Fig. S6. Distribution of responses to “The environment is important to me”

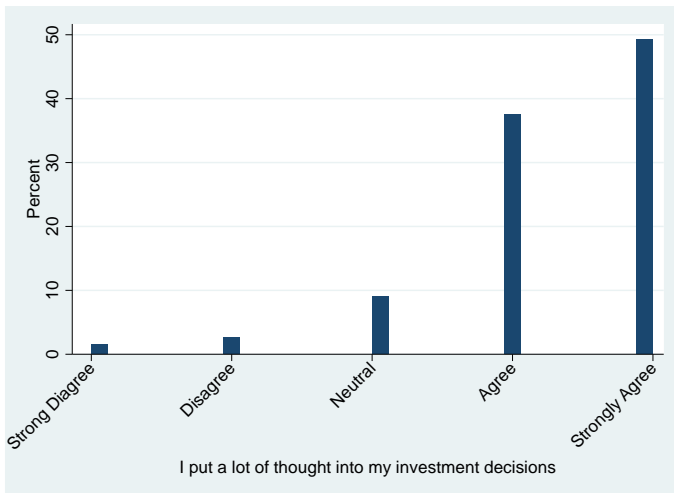


Fig. S7. Distribution of responses to “I put a lot of thought into my investment decisions”

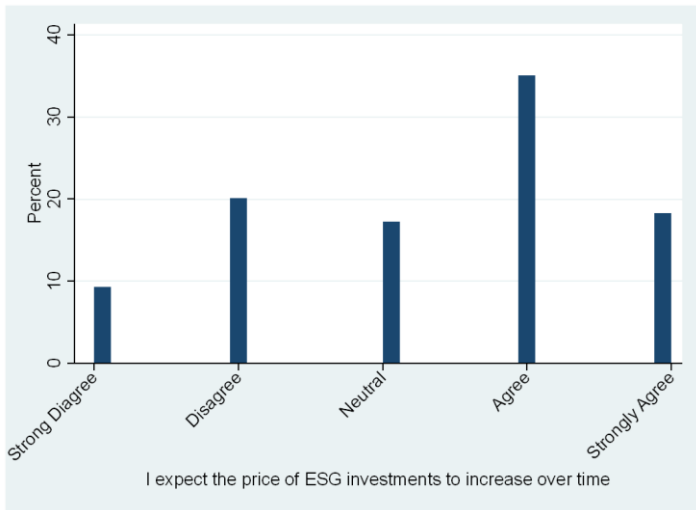


Fig. S8. Distribution of responses to “I expect the Price of ESG investments to increase over time”

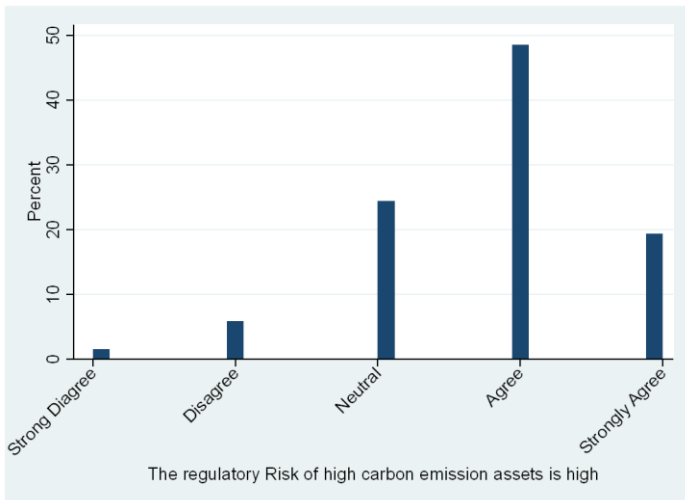


Fig S9. Distribution of responses “The regulatory risk of high carbon emission assets is high”

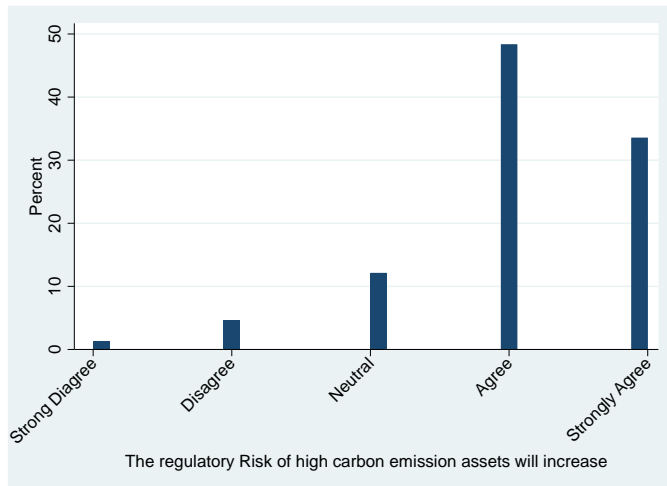


Fig. S10. Distribution of responses “The regulatory risk of high carbon emission assets will increase”

Panel Regression Analysis

Panel regression analysis is applied to more carefully examine the relationship between the framing conditions and the individual participant’s optimistic orientation. We measure the influence of the Optimism frame (and other) conditions, and then combine this influence with the their level of optimism as measured by the LOT-R instrument.

To measure the influence of the conditions, we compare the sustainable investment choices of each individual with the average choices for each scenario. Naturally, there will be different preferences under each scenario. For example, there should be higher sustainable preferences if there are lower ESG charges. However, we are particularly concerned with how this pattern of preferences is affected by the communication frame. We therefore set the difference between an individual’s preferences and the average preferences for each scenario as the dependent variable. This variable is then modelled using an indicator variable for each condition, control variables (eg age and female) and an optimism indicator variable.

The individual’s measure of optimism is transformed into an indicator variable where one is the value for those with above average optimism and zero is the value for those with below average optimism. By combining this indicator variable with the indicator representing the optimism condition, we can discern the marginal effect from these two dimensions – i.e., optimistic investors responding to an optimistic message.

A panel regression is an appropriate structure because all individual participants are exposed to the full range of scenarios (similar to a time series data set) with each scenario containing different ESG charges and volatilities. The panel therefore consists of individual participants by the six scenarios. The three conditions are represented by indicator variables (contrasting with the Control condition) and the interaction term will show the effect of optimistic individuals acting under the Optimism frame condition. Control variables reflect the varying ages and which individuals were female. The regression model therefore takes the form:

$$(S_{ijk} - C_j) = a_0 + a_5 Norm + a_6 Msg + a_7 Opt + a_8 Age_i + a_9 Female_i + a_1 ESG_Con_j + a_2 ESG_Bal_j + a_3 (Vol_{ESG_{Con}_j} - Vol_{Con_j}) + a_4 (Vol_{ESG_{Bal}_j} - Vol_{Bal_j}) + a_{10} Optimistic_i + a_{11} Norm_i \times Optimistic_i + a_{12} Msg_i \times Optimistic_i + a_{13} Opt_i \times Optimistic_i$$

Where

S_{ijk} = Proportion sustainably allocated by participant i under scenario j in treatment k

C_j = Average proportion sustainably allocated by participants under scenario j in control treatment

a_0 = constant and a_1 to a_{13} = coefficients for variables

$Norm, Msg$ and Opt = Indicator variables for Norms, Messenger and Optimism treatments

Age_i and $Female_i$ = control variables for age and female

ESG_Con_j = ESG charge for conservative option in scenario j

ESG_Bal_j = ESG charge for balanced option in scenario j

$Vol_ESG_Con_j$ = Volatility of conservative option in scenario j

Vol_Con_j = Volatility of conservative option in scenario j

$Vol_ESG_Bal_j$ = Volatility of balanced option in scenario j

Vol_Bal_j = Volatility of balanced option in scenario j

$Optimistic_i$ = Indicator variable for above medium optimism score

$Norm_i \times Optimistic_i$ = interactive variable for the Norms treatment and the optimistic indicator variable

$Msg_i \times Optimistic_i$ = interactive variable for the Messenger treatment and the optimistic indicator variable

$Opt_i \times Optimistic_i$ = interactive variable for the Optimism treatment and the optimistic indicator variable

The interaction between optimism and an optimistic message is the most prominent finding from the panel regression. The results in Table 2 show a significant interaction effect between the optimistic individuals and the Optimism condition – i.e., for the variable $Opt_i \times Optimistic_i$.

Dependent Variable: ESG Invested (%)	Coefficient	(Robust Std Error)
Variables		
Constant	1.099	(8.729)
Norms	-0.235	(10.67)
Optimism	-18.80**	(8.388)
Messenger	-16.22	(11.19)
Age	0.182	(0.125)
Female	2.679	(2.613)
Conventional option ESG charge	-0.682	(0.929)
Balanced option ESG charge	0.235	(0.829)
Conventional option risk difference	-2.776	(2.585)
Conventional option risk difference	1.385	(1.573)
Optimistic	-10.27	(7.233)
Norms x Optimistic	-0.948	(12.19)
Optimism x Optimistic	29.13***	(9.189)
Messenger x Optimistic	19.45	(12.05)
Observations	2,010	
Number of id	335	

Table S2. Regression results for the effect of variables on percentage of ESG invested compared to the average invested for each scenario. Notes: *** p<0.01, ** p<0.05, * p<0.1

Textual Analysis of Frames for Comparison

As the framing of preambles constitutes our main exogenous change, we have taken great care to make them as comparable as possible while achieving the desired experimental variation. We provide objective evidence below using text content analysis to demonstrate that the content and length of the text between the conditions are relatively invariant except for the framing. Output from app.copyleaks.com objectively assigned a 100% match with 203 similar words from a comparison of the Control frame (Left) to the Social Norm frame (right).

Please see output below. As it illustrates, the Norms frame content differs only by a few words needed to frame the content as a social norm: “Most investors are now realising that..” ... “at the same time as everyone else.”

The screenshot displays the Copyleaks interface for a text scan. At the top, it shows 'SCAN PROPERTIES' with a gear icon. The main summary area includes: 'DONE' (Scanned a minute ago), '1 RESULTS FOUND', '203 SIMILAR WORDS', a large red circle representing the match percentage, and a '100% MATCH' badge. A legend indicates: Identical (100%), Minor changes (0%), Paraphrased (0%), and Omitted Words (0%). Below this, two text samples are compared side-by-side. The left sample is labeled 'SUBMITTED TEXT' and the right is 'Your File'. Both samples contain identical text with several lines highlighted in red. The text in both samples is: 'International financial monitoring bodies warn global warming is now a major financial risk. There would be impact on global portfolio holdings if appropriate incentives to reduce greenhouse gas emissions were instituted worldwide. High carbon emission assets would become less valuable and the valuations of companies holding those assets would fall. As expectations of such policies being implemented grow, there is a greater risk of fossil fuel assets becoming stranded assets. While the absolute size of those stranded assets in some investment portfolios may be small, there are tiny holdings of stranded assets in many portfolios, making it difficult and expensive to arrange to sell all those assets. The investor's decision therefore needs to consider the management of portfolio risk in the face of our understanding of the reality of the externalities created by burning fossil fuels, the likelihood that stranded assets would underperform, and the desire to position aligned portfolios with the investor's mission. Please take as much time as you need. You will be able to proceed to the next step after 60 seconds. Please note that you can still take more time to read the provided information. Please click "next" only after you've had a chance to read the text thoroughly.'

Similar reports were done comparing the Optimism text to the Control (as with the Social Norm there were 203 words similar, 100% match), and Messenger text to the Control (183 words similar, 90.1% match). The comparability of content between conditions is consistent with conditions being a 90% match or above in textual analysis.

F. STATA Code

```
* condition
* 0 = Control
* 1 = Norms
* 2 = Optimism
* 3 = Messenger

* Generate portfolio choice dummies
gen pc1 =0
gen pc2 =0
gen pc3 =0
gen pc4 =0
gen pc5 =0
gen pc6 =0

* reshape command Convert data from wide form to long form

reshape long pc , i(id) j(portfolio)

* Create condition dummies

gen t1 = 0
replace t1=1 if treatment ==1
gen t2 = 0
replace t2= 1 if treatment ==2
gen t3 =0
replace t3= 1 if treatment ==3

* Create pc dummies again (ommitting pc1)

rename pc pc2
replace pc2 =1 if portfolio ==2
gen pc3 =0
replace pc3 =1 if portfolio ==3
gen pc4 =0
replace pc4=1 if portfolio ==4
gen pc5 = 0
replace pc5 =1 if portfolio ==5
gen pc6 = 0
replace pc6= 1 if portfolio ==6

* Create ESG % total allocation
gen esg_pct = (.)
replace esg_pct = (pc1_esc_con + pc1_esc_bal) if portfolio==1
replace esg_pct = (pc2_esc_con + pc2_esc_bal) if portfolio==2
replace esg_pct = (pc3_esc_con + pc3_esc_bal) if portfolio==3
replace esg_pct = (pc4_esc_con + pc4_esc_bal) if portfolio==4
replace esg_pct = (pc5_esc_con + pc5_esc_bal) if portfolio==5
replace esg_pct = (pc6_esc_con + pc6_esc_bal) if portfolio==6

* Create ESG % Conservative allocation
```

```
gen esg_pct_con = (.)
replace esg_pct_con = pc1_esc_con if portfolio==1
replace esg_pct_con = pc2_esc_con if portfolio==2
replace esg_pct_con = pc3_esc_con if portfolio==3
replace esg_pct_con = pc4_esc_con if portfolio==4
replace esg_pct_con = pc5_esc_con if portfolio==5
replace esg_pct_con = pc6_esc_con if portfolio==6
```

* Create ESG % Balanced allocation

```
gen esg_pct_bal = (.)
replace esg_pct_bal = pc1_esc_con if portfolio==1
replace esg_pct_bal = pc2_esc_con if portfolio==2
replace esg_pct_bal = pc3_esc_con if portfolio==3
replace esg_pct_bal = pc4_esc_con if portfolio==4
replace esg_pct_bal = pc5_esc_con if portfolio==5
replace esg_pct_bal = pc6_esc_con if portfolio==6
```

* Dummy = 1 if YES to 1m, 1 yr, 10yrs "I do not plan to increase my share of ESG investments personal portfolio"

```
gen intention = 0
replace intention = 1 if att02sq001=="Yes"
replace intention = 1 if att02sq002=="Yes"
replace intention = 1 if att02sq003=="Yes"
gen intention_1y = 0
replace intention_1y = 1 if att02sq001=="Yes"
replace intention_1y = 1 if att02sq002=="Yes"
```

* Create variable for allocation to option A

```
gen a = (.)
replace a = pc1_fossil_con if portfolio==1
replace a = pc2_fossil_con if portfolio==2
replace a = pc3_fossil_con if portfolio==3
replace a = pc4_fossil_con if portfolio==4
replace a = pc5_fossil_con if portfolio==5
replace a = pc6_fossil_con if portfolio==6
```

* Create variable for allocation to option B

```
gen b = (.)
replace b = pc1_esc_con if portfolio==1
replace b = pc2_esc_con if portfolio==2
replace b = pc3_esc_con if portfolio==3
replace b = pc4_esc_con if portfolio==4
replace b = pc5_esc_con if portfolio==5
replace b = pc6_esc_con if portfolio==6
```

* Create variable for allocation to option C

```
gen c = (.)
replace c = pc1_fossil_bal if portfolio==1
replace c = pc2_fossil_bal if portfolio==2
replace c = pc3_fossil_bal if portfolio==3
replace c = pc4_fossil_bal if portfolio==4
replace c = pc5_fossil_bal if portfolio==5
```

```

replace c = pc6_fossil_bal if portfolio==6
* Create variable for allocation to option D
gen d = (.)
replace d = pc1_esc_bal if portfolio==1
replace d = pc2_esc_bal if portfolio==2
replace d = pc3_esc_bal if portfolio==3
replace d = pc4_esc_bal if portfolio==4
replace d = pc5_esc_bal if portfolio==5
replace d = pc6_esc_bal if portfolio==6

* Naive Diversification between conditions

gen naive_diversification=(0)

replace naive_diversification=1 if a == 25 & b == 25 & c == 25 & c ==25

graph bar naive_diversification, over(treatment, label(labsize(large))) ///
relabel(1 "Control" 2 "Norms" 3 "Optimism" 4 "Messenger") ///
blabel(bar, format(%4.2f) size(large)) ///
ytittle("Naive Diversification (Proportion)", size(large)) ///
yscale(range(0 1)) ylabel(0.2 0.4 0.6 0.8 1) ///
graphregion(color(white)) bar(1, fcolor(gray 9))

* Reverse code item 3 in Optimism Score

replace op01sq003 = 1 if op01sq003==5
replace op01sq003 = 2 if op01sq003==4
replace op01sq003 = 4 if op01sq003==2
replace op01sq003 = 5 if op01sq003==1

* Generate Aggregate Optimism Score from 3 items

gen optscore = (.)
replace optscore = op01sq001 + op01sq002 + op01sq003
summarize optscore

* Create dummy for optimism *****

gen optimism = 1
replace optimism = 0 if optscore<11

* rename variable

rename demo02 age

* Create female dummy variable from str variable

encode demo01, gen(female)
label values female .
replace female = 0 if female==2

* Create variable for total % in Conservative allocation

```

```
gen con_pct = a + b
```

```
* Create variable for total % in Balanced allocation
```

```
gen bal_pct = c + d
```

```
order pc2 pc3 pc4 pc5 pc6 esg_pct con_pct bal_pct a b c d t1 t2 t3 female demo01, before (condition)
```

```
* Create Interaction Variables
```

```
gen t1age = age*t1
```

```
gen t2age = age*t2
```

```
gen t3age = age*t3
```

```
gen t1optimism =t1*optimism
```

```
gen t2optimism =t2*optimism
```

```
gen t3optimism =t3*optimism
```

```
*gen t1optscore =t1*optscore Decided to create a single dummy for optimism
```

```
*gen t2optscore =t2*optscore
```

```
*gen t3optscore =t3*optscore
```

```
gen t1fp = t1*fp
```

```
gen t2fp = t2*fp
```

```
gen t3fp = t3*fp
```

```
gen t1sp = t1*fp
```

```
gen t2sp = t2*fp
```

```
gen t3sp = t3*fp
```

```
gen t1fm = t1*fm
```

```
gen t2fm = t2*fm
```

```
gen t3fm = t3*fm
```

```
* pc and treatment interactions
```

```
gen pc2t1 = pc2*t1
```

```
gen pc3t1 = pc3*t1
```

```
gen pc4t1 = pc4*t1
```

```
gen pc5t1 = pc5*t1
```

```
gen pc6t1 = pc6*t1
```

```
gen pc2t2 = pc2*t2
```

```
gen pc3t2 = pc3*t2
```

```
gen pc4t2 = pc4*t2
```

```
gen pc5t2 = pc5*t2
```

```
gen pc6t2 = pc6*t2
```

```
gen pc2t3 = pc2*t3
```

```
gen pc3t3 = pc3*t3
```

```
gen pc4t3 = pc4*t3
```

```
gen pc5t3 = pc5*t3
```

```
gen pc6t3 = pc6*t3
```

* Dummy if agree to "the environment is important to me"

gen important = (.)

replace important = 1 if att01sq002>3

replace important = 0 if att01sq002<4

* Dummy = 0 if YES to "I do not plan to increase my share of ESG investments ///

* personal portfolio - In ONE Month"

gen personalportfolio1m = (.)

replace personalportfolio1m = 1 if att02sq001=="Yes"

replace personalportfolio1m = 0 if att02sq001=="No"

count if personalportfolio1m == 1

count if personalportfolio1m == 1 & treatment ==0

count if personalportfolio1m == 1 & treatment ==1

count if personalportfolio1m == 1 & treatment ==2

count if personalportfolio1m == 1 & treatment ==3

*****Summary Statistics Mean sd*****

summarize esg_pct if intention==1 & org!=2 & treatment==0

summarize esg_pct if intention==1 & org!=2 & treatment==1

summarize esg_pct if intention==1 & org!=2 & treatment==2

summarize esg_pct if intention==1 & org!=2 & treatment==3

* Optimists

summarize esg_pct if intention==1 & org!=2 & optimism==1 & treatment==0

summarize esg_pct if intention==1 & org!=2 & optimism==1 & treatment==1

summarize esg_pct if intention==1 & org!=2 & optimism==1 & treatment==2

summarize esg_pct if intention==1 & org!=2 & optimism==1 & treatment==3

* Pessimists

summarize esg_pct if intention==1 & org!=2 & optimism==0 & treatment==0

summarize esg_pct if intention==1 & org!=2 & optimism==0 & treatment==1

summarize esg_pct if intention==1 & org!=2 & optimism==0 & treatment==2

summarize esg_pct if intention==1 & org!=2 & optimism==0 & treatment==3

* t-tests***** all portfolios*****

gen esgpct_control = esg_pct if treatment==0 & intention==1 & org!=2

gen esgpct_norms = esg_pct if treatment==1 & intention==1 & org!=2

gen esgpct_optimism = esg_pct if treatment==2 & intention==1 & org!=2

gen esgpct_messenger = esg_pct if treatment==3 & intention==1 & org!=2

*robustness check, comment out relevant exclusion criteria when executing

gen esgpct_control = esg_pct if treatment==0 / & org!=2 /* & intention==1

gen esgpct_norms = esg_pct if treatment==1 / & org!=2 /* & intention==1

gen esgpct_optimism = esg_pct if treatment==2 / & org!=2 /* & intention==1

gen esgpct_messenger = esg_pct if treatment==3 / & org!=2 /* & intention==1

tttest esgpct_control = esgpct_norms, unpaired unequal

```

ttest esgpct_control = esgpct_optimism, unpaired unequal
ttest esgpct_control = esgpct_messenger, unpaired unequal

* test esgpct_optimism and optimimists esgpct_optimism

gen esgpct_optimism_opt = esgpct_optimism if optimism==1
ttest esgpct_optimism_opt = esgpct_optimism, unpaired unequal

* test optimists in OPT Condition compared to optimists in Control condition
gen esgpct_control_opt = esgpct_control if optimism==1
ttest esgpct_optimism_opt = esgpct_control_opt, unpaired unequal

* test optimists in NORMS Condition compared to optimists in Control condition
gen esgpct_norms_opt = esgpct_norms if optimism==1
ttest esgpct_norms_opt = esgpct_control_opt, unpaired unequal

* test optimists in MESSENGER Condition compared to optimists in Control condition
gen esgpct_messenger_opt = esgpct_messenger if optimism==1
ttest esgpct_messenger_opt = esgpct_control_opt, unpaired unequal

* test optimists in OPT Condition compared to Pessimists in OPT condition
gen esgpct_optimism_pessimist = esgpct_optimism if optimism==0
ttest esgpct_optimism_opt = esgpct_optimism_pessimist, unpaired unequal

* test optimists in Messenger Condition compared to Pessimists in Messenger condition
gen esgpct_messenger_pessimist = esgpct_optimism if optimism==0
ttest esgpct_messenger_opt = esgpct_messenger_pessimist, unpaired unequal

* test optimists in Norms Condition compared to Pessimists in Norms condition
gen esgpct_norms_pessimist = esgpct_norms if optimism==0
ttest esgpct_norms_opt = esgpct_norms_pessimist, unpaired unequal

* test optimists in Control Condition compared to Pessimists in Control condition
gen esgpct_control_pessimist = esgpct_control if optimism==0
ttest esgpct_control_opt = esgpct_control_pessimist, unpaired unequal

*** t-tests conservative (b) and balanced options separately (d)*****

gen esgcon_control = b if treatment==0 & intention==1 & org!=2
gen esgcon_norms = b if treatment==1 & intention==1 & org!=2
gen esgcon_optimism = b if treatment==2 & intention==1 & org!=2
gen esgcon_messenger = b if treatment==3 & intention==1 & org!=2

gen esgbal_control = d if treatment==0 & intention==1 & org!=2
gen esgbal_norms = d if treatment==1 & intention==1 & org!=2
gen esgbal_optimism = d if treatment==2 & intention==1 & org!=2
gen esgbal_messenger = d if treatment==3 & intention==1 & org!=2

ttest esgcon_control = esgcon_norms, unpaired unequal
ttest esgcon_control = esgcon_optimism, unpaired unequal
ttest esgcon_control = esgcon_messenger, unpaired unequal

ttest esgbal_control = esgbal_norms, unpaired unequal

```

```
ttest esgbal_control = esgbal_optimism, unpaired unequal
ttest esgbal_control = esgbal_messenger, unpaired unequal
```

```
sum b if treatment==0 & intention==1 & org!=2
sum b if treatment==1 & intention==1 & org!=2
sum b if treatment==2 & intention==1 & org!=2
sum b if treatment==3 & intention==1 & org!=2
```

```
sum d if treatment==0 & intention==1 & org!=2
sum d if treatment==1 & intention==1 & org!=2
sum d if treatment==2 & intention==1 & org!=2
sum d if treatment==3 & intention==1 & org!=2
```

```
**** Robustness check 50% randomly drawn sample *
```

```
*sample 50 if treatment == 2
*graph bar (mean) esg_pct if intention==1 & org!=2, ytitle("ESG Invested %", size(large)) ///
*over(treatment, label(labsize(large)) relabel(1 "Control" 2 "Norms" 3 "Optimism" 4 "Messenger"))
///
*yscale(range(0 100)) ylabel(20 40 60 80 100) graphregion(color(white)) ///
*lblabel(bar, format(%4.2f) size(large)) bar(1, fcolor(gray))
```

```
*****Effect size*****
```

```
esize unpaired esgpct_optimism == esgpct_control //Cohen's d 0.11
esize unpaired esgpct_optimism_opt == esgpct_control_opt //Cohen's d 0.32
esize unpaired esgpct_optimism_opt == esgpct_optimism_pessimist //Cohen's d 0.46
esize unpaired esgpct_messenger_opt == esgpct_messenger_pessimist //Cohen's d 0.29
esize unpaired esgpct_norms_opt == esgpct_norms_pessimist //Cohen's d 0.27
esize unpaired esgbal_control == esgbal_optimism
esize unpaired esgcon_control == esgcon_optimism
```

```
***** GRAPHS *****
```

```
* Graph %ESG by 6 Portfolios ***
```

```
graph bar (mean) esg_pct if intention==1 & org!=2, ytitle("ESG Invested %", size(large)) ///
over(portfolio) over(treatment, label(labsize(large)) ///
relabel(1 "Control" 2 "Norms" 3 "Optimism" 4 "Messenger")) ///
yscale(range(0 100)) ylabel(20 40 60 80 100) ///
graphregion(color(white)) bar(1, fcolor(gray 9))
```

```
* ESG% by Condition
```

```
graph bar (mean) esg_pct if intention==1 & org!=2, ytitle("ESG Invested %", size(large)) ///
over(treatment, label(labsize(large)) relabel(1 "Control" 2 "Norms" 3 "Optimism" 4 "Messenger")) ///
yscale(range(0 100)) ylabel(20 40 60 80 100) graphregion(color(white)) ///
lblabel(bar, format(%4.2f) size(large)) bar(1, fcolor(gray))
```

```
* ESG% by Condition, Optimists
```

```
graph bar (mean) esg_pct if intention==1 & org!=2 & optimism==1, ytitle("ESG Invested %",
size(large)) ///
over(treatment, label(labsize(large)) relabel(1 "Control" 2 "Norms" 3 "Optimism" 4 "Messenger")) ///
```

```
yscale(range(0 100)) ylabel(20 40 60 80 100) graphregion(color(white)) ///  
lblabel(bar, format(%4.2f) size(large)) bar(1, fcolor(gray))  
graph export graph_esg_condition_optimists.png, replace
```

* Graph %ESG by 6 Portfolios for CONSERVATIVE

```
graph bar (mean) b if intention==1 & org!=2, ///  
ytitle("ESG Invested %", size(large)) over(portfolio) ///  
over(treatment, label(labsize(large))) ///  
relabel(1 "Control" 2 "Norms" 3 "Optimism" 4 "Messenger") ///  
graphregion(color(white)) yscale(range(0 60)) ///  
ylabel(10 20 30 40 50 60) bar(1, fcolor(gray 9))
```

* Graph %ESG by 6 Portfolios for BALANCED

```
graph bar (mean) d if intention==1 & org!=2, ///  
ytitle("ESG Invested %", size(large)) over(portfolio) ///  
over(treatment, label(labsize(large))) ///  
relabel(1 "Control" 2 "Norms" 3 "Optimism" 4 "Messenger") ///  
graphregion(color(white)) yscale(range(0 60)) ///  
ylabel(10 20 30 40 50 60) bar(1, fcolor(gray 9))
```

* Graphs of questionnaire responses

```
histogram optscore, percent xlabel(#15)  
histogram att01sq001, percent color(navy) xlabel(1 "Strong Diagree" ///  
2 "Disagree" 3 "Neutral" 4 "Agree" 5 "Strongly Agree", angle(forty_five) ) ///  
xtitle("I expect the price of ESG investments to increase over time")
```

```
histogram att01sq002, percent color(navy) xlabel(1 "Strong Diagree" ///  
2 "Disagree" 3 "Neutral" 4 "Agree" 5 "Strongly Agree", angle(forty_five) ) ///  
xtitle("The environment is important to me")
```

```
histogram att01sq003, percent color(navy) xlabel(1 "Strong Diagree" ///  
2 "Disagree" 3 "Neutral" 4 "Agree" 5 "Strongly Agree", angle(forty_five) ) ///  
xtitle("I put a lot of thought into my investment decisions")  
graph export ThoughtQ_histogram.wmf, replace
```

```
histogram att01sq004, percent color(navy) xlabel(1 "Strong Diagree" ///  
2 "Disagree" 3 "Neutral" 4 "Agree" 5 "Strongly Agree", angle(forty_five) ) ///  
xtitle("The regulatory Risk of high carbon emission assets is high")  
graph export Reg_riskQ1_histogram.wmf, replace
```

```
histogram att01sq005, percent color(navy) xlabel(1 "Strong Diagree" ///  
2 "Disagree" 3 "Neutral" 4 "Agree" 5 "Strongly Agree", angle(forty_five) ) ///  
xtitle("The regulatory Risk of high carbon emission assets will increase")  
graph export Reg_riskQ2increase_histogram.wmf, replace
```

```
histogram att01sq005, percent color(navy) xlabel(1 "Strong Diagree" ///  
2 "Disagree" 3 "Neutral" 4 "Agree" 5 "Strongly Agree", angle(forty_five) ) ///  
xtitle("The regulatory Risk of high carbon emission assets will increase")
```

* Balance table

* Average Age

egen meanage=mean(age)

* Average Age

summarize age if treatment==0

summarize age if treatment==1

summarize age if treatment==2

summarize age if treatment==3

* optscore

summarize optscore if treatment==0

summarize optscore if treatment==1

summarize optscore if treatment==2

summarize optscore if treatment==3

*Average experience demo04

summarize demo04 if treatment==0

summarize demo04 if treatment==1

summarize demo04 if treatment==2

summarize demo04 if treatment==3

*****REGRESSIONS*****

* Random Effects Regression

*tsset id portfolio

*xtreg esg_pct bal_pct t1 t2 t3 pc2 pc3 pc4 pc5 pc6 age female ///

*optimism t1optimism t2optimism t3optimism if intention==1 & org!=2, robust cluster(id)

sort portfolio

merge portfolio using ave_esg_pct

sort id portfolio treatment esg_pct bal_pct female demo01

drop _merge

generate esg_pct_diff = esg_pct - ave_esg_pct

label variable esg_pct_diff "ESG allocation vs average for scenario"

tsset id portfolio

xtreg esg_pct_diff t1 t2 t3 age female cons_esg_chg bal_esg_chg cons_esg_vol_diff bal_esg_vol_diff
ln_bal_pct ///

optimism t1optimism t2optimism t3optimism if intention==1 & org!=2, robust cluster(id)

outreg2 using esg_pct_diff.doc, keep(t1 t2 t3 age female cons_esg_chg bal_esg_chg

cons_esg_vol_diff ///

bal_esg_vol_diff ln_bal_pct optimism t1optimism t2optimism t3optimism) replace title(Regression
results) ///

ctitle(with log bal alloc) label