Sustainability, Prices and Emotions

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Abstract

We examine whether the sustainable character of an investment impacts asset prices in experimental asset markets. We use asset markets with the structure introduced by Smith, Suchanek, and Williams (1988) to investigate the impact of positive, neutral, and negative sustainability attributes. Prior studies suggest that investors experience positive emotions when choosing a sustainable investment and that positive emotions correlate with purchases and overpricing. Our design allows for simultaneous observations of both phenomena and we find that sustainability positively influences asset prices through the channels of preferences and emotions, which we measure using face-reading software. Moreover, the fraction of female traders increases overpricing given that the asset is sustainable.

Introduction

Sustainable investments have grown drastically in recent years. According to SIF (2022), there are 8.4 trillion dollars of assets under management in sustainable products as of the end of 2021[1]. Thus, understanding sustainable investment behavior is vital as it can provide important asset price implications. In this paper, we analyze how social preferences and emotions affect asset prices in a double-auction market dependent on the sustainability level of the asset. We investigate the effect of positive, neutral and negative sustainability information on price levels and how preferences shape this effect. Moreover, we analyze how sustainability levels impact emotions and how emotions, in turn, influence trading behavior.

A large strand of literature shows that sustainability levels influence investment decisions. Regarding investor characteristics, studies suggest that people with higher social preferences are more likely to invest sustainably (Riedl and Smeets, 2017b; Bauer et al., 2021; Riedl and Smeets, 2017a). In our study, we accordingly analyze whether average social preference levels within a trading cohort influence the price level of the asset. Additionally, it has been shown that sustainability shapes people's perceptions about the risks and returns of an investment (Hartzmark and Sussman, 2019) and that investors experience positive emotions when choosing a sustainable investment (Heeb et al., 2023). Both of these observations suggest the presence of the affect heuristic in sustainable investment decisions. The affect heuristic describes a phenomenon whereby people evaluate the risks and benefits of a choice set based on emotions rather than reason by not adequately weighing the pros and cons, especially if a decision is hard (Finucane et al., 2000). This phenomenon has been shown to influence risk-taking behavior. For instance, there is evidence that positive affect increases risk-taking (Isen and Patrick, 1983; Kuhnen and Knutson, 2011; Johnson and Tversky, 1983). One mechanism for the effect of positive affect on risk-taking is that it leads to decreases in the assessment of the likelihood of unfavorable events, which can result in the overestimation of dividends and prices (Breaban and Noussair, 2018). On the other hand, fear has been associated with a risk-averse attitude (Lerner and Keltner, 2001; Nguyen and Noussair, 2014), leading in turn to lower prices (Breaban and Noussair, 2015).

The link between emotions and expected risks and returns documented in the literature raises the question as to what extent these emotions affect investors' behavior when facing

[1] `https://www.ussif.org/blog$_$home.asp?Display=194`

a sustainable investment decision. Particularly, it is interesting to examine whether the positive emotions that investors experience when investing sustainably lead to an increase in asset prices. To test this, we exploit the market setting by Smith et al. (1988) where asset-pricing bubbles are expected to arise. While the majority of experimental studies of asset-pricing bubbles have emphasized non-emotional factors such as liquidity, experience, transparency, novelty of environment, and speculation (Caginalp et al., 2001; Lei et al., 2001; Dufwenberg et al., 2005; Hussam et al., 2008), emotional factors have also been shown to affect asset prices and thus the magnitude of bubbles (Andrade et al., 2016; Breaban and Noussair, 2018). Specifically, there is evidence that positive emotions on the part of the investor lead to overpricing. For example, Andrade et al. (2016) show that excitement (a highly intense, positive emotion) magnifies the size of asset-pricing bubbles. Breaban and Noussair (2018) document that positive emotions correlate with purchases and overpricing. Thus, if investors indeed associate positive emotions with a sustainable asset, we should expect its price to be higher than the price of a less sustainable asset.

We posit that the concept of emotions affecting asset prices is especially relevant for sustainable investments since positive emotions are collectively associated with characteristics of the asset that are not directly linked to financial information. This could lead to less calculated decisions by investors, potentially driving up asset prices. However, sustainable investment decisions might also be particularly stable if they stem from preferences and moral convictions rather than return expectations. Previous empirical literature gives insights on how the sustainability level of a fund or stock influences investment decisions. Bollen (2007) observe that cash flows into socially responsible funds are more sensitive to positive lagged returns than conventional funds while Renneboog et al. (2011) show that only money flows into funds with environmental screens are more sensitive to lagged positive returns. Both studies agree that socially responsible funds are less sensitive to negative lagged returns. Anderson and Robinson (2019) observe that as a reaction to fear after the exposure to a climate crisis, investors rebalance their portfolios towards more green investments, tend to think that green investments outperform, and are willing to pay higher fees for green mutual funds.

Within our study, we also investigate the difference between positive and negative sustainability information on asset prices and trading behavior. While there is empirical evidence for the punishment of investors for sin stocks (Hong and Kacperczyk, 2009), evidence on rewarding green securities has been mixed (Larcker and Watts, 2020; Flam-

mer, 2021), pointing to an asymmetry in the assessment of both stock types. Indeed, the experimental study by Humphrey et al. (2021) finds that negative externalities of the same magnitude have a larger impact on investment decisions than positive externalities. Similarly, Berg et al. (2022) find that ESG rating downgrades lead to a long-term negative stock returns response, whereas upgrades result in a weaker and slower positive response. Krüger (2015) documents that investors' reaction to negative CSR events is stronger in absolute terms than their reaction to positive CSR events.

By further analyzing investors' willingness to pay for sustainable assets, many studies focus on the role of impact. Heeb et al. (2023) find that people are willing to pay for impact while they do not pay significantly more for more impact in a setting where they are not aware of the monetary equivalent. Similarly, Bonnefon et al. (2022) observe that externalities have an effect on people's willingness to pay but is not affected by the impact of their actual decision.

Finally, Heeb et al. (2023) and Merkle (2022) experimentally test the role of emotions in sustainable investment decisions. Heeb et al. (2023) observe that investors experience positive emotions when investing sustainably and base their WTP decisions on their emotions rather than impact cost evaluations, suggesting "warm glow" as a driver for investors' choices. Merkle (2022) provides experimental evidence that investors rely on the affect heuristic when evaluating companies' risk, returns and ESG performance. These findings suggest that sustainable investment decisions are influenced by emotions, giving rise to the possibility of irrationality. We investigate this possibility by examining whether positive and negative sustainability information have an effect on the size of price bubbles and by analyzing the role of emotions.

Our study aims to show the price impact that positive affect associated with sustainable investments has on asset markets. Since it is difficult to make causal inferences about the role of sustainability levels for asset prices from field data, we run a series of experimental markets. Our laboratory experiment allows for the investigation of the effect of sustainability information in a setting with collective decision-making. Our treatments are designed to induce positive, neutral, or negative emotions through the incorporation of good, neutral, and bad information on the sustainability performance of firms. By design, there is no difference in the transparently communicated expected value of the assets. Additionally, holding or purchasing the asset has no pro-social impact, which we tell subjects. This means that we can rule out subjects having the goal of driving prices

up or down to match impact-seeking preferences. We use a bubble-prone experimental market setting (Smith et al., 1988; Caginalp et al., 2001) which means that we test for differences to an already overpriced asset instead of claiming that the sustainability aspect alone can generate bubbles.

To directly test whether our treatments induce the expected emotions in subjects, we use the Noldus face-reading software which measures subjects' emotions during the experiment using their facial expressions. We primarily focus on valence, i.e. the overall positivity of an emotional state and fear as our main variables for emotion levels. We are not aware of any other study that directly measures emotions in a sustainable investment setting. If the manipulation of sustainability information results in the hypothesized emotions, we should expect to see the corresponding effect on asset prices in the different treatments.

Our paper contributes to the literature that investigates mechanisms behind and pricing implications of sustainable investing. Most closely related to our study is Heeb et al. (2023) who elicit perceived emotions and use them as an explanation for investors' lack of willingness to linearly pay more for more impact. However, for their measure of emotions they solely rely on investors' subjective survey responses about the perceptions of their own emotions. In our study, we can measure emotions beyond the usage of a survey and over time. As a result, we can draw inferences about the relationship between emotions and participants' trading behavior.

Our study also contributes to the literature which experimentally investigates the effect of sustainability levels on investors' willingness to pay. The key difference between ours and other studies is our usage of a double-auction market. Previous studies (Heeb et al., 2023; Bonnefon et al., 2022; Humphrey et al., 2021) do not study the effect of market dynamics on prices of (un-)sustainable assets. It has been shown that market interaction changes subjects' levels of moral behavior Falk and Szech (2013). Therefore, it is important to investigate whether or not prices in a market context are affected by an asset's degree of sustainability, as prior studies without interactive trading would suggest. At the same time, the usage of a double-auction market introduces the effect of speculation on trading decisions and might impact the valuation difference between positive and negative sustainability attributes.

Lastly, our work contributes to the literature that examines the role of affect in financial decision-making (Finucane et al., 2000; Slovic et al., 2007). Affective decisions have

been provided as explanations for investors' irrational behavior, such as biased financial expectations (MacGregor et al., 2000; Ganzach, 2000; Statman et al., 2008; Kempf et al., 2014; Hartzmark and Sussman, 2019; Merkle, 2022), home bias (Huberman, 2001; Strong and Xu, 2003), or overpricing (Andrade et al., 2016; Breaban and Noussair, 2018). We show that emotions, gender and preferences affect sustainable investment decisions and highlight the importance of emotions that market participants collectively associate with an asset class.

Experimental Design

Three-hundred and fifty-one subjects were recruited from LMU Munich's MELESSA lab student subject pool via the recruitment tool ORSEE. Subjects were paid a show-up fee of 6 Euros and a performance-based fee from trading averaging 10.90 Euros, resulting in an average payment of 16.90 Euros.

The structure of our experimental markets is based on the well-studied design introduced by Smith et al. (1988), henceforth SSW. [2] Our subjects are initially endowed with cash and shares where the amount of cash is greater than or equal to the shares' values. The asset has a finite lifetime of 15 periods, and subjects trade its shares in a continuous double auction. The latter allows each subject to take on the role of both the buyer and seller. The asset pays a random dividend that is independently drawn from a known distribution at the end of each trading period. The dividend has four potential outcomes of 0, 8, 28, and 60 Experimental Currency Units (ECU) with equal probabilities so that the expected dividend for each period is equal to 24 ECU. The dividend payments are intended to generate frequent inflows of cash into the market, leading to an average increase in the available cash in the market of 24 ECU in each period. Such an increasing C/A ratio has been shown to increase mispricing (Kirchler et al., 2012). Dividends are the only source of value for the asset. Thus, the fundamental value of the asset at the beginning of the experiment is equal to 360 ECU. After each period, the fundamental value decreases by the amount of the expected dividend of 24 ECU. At the end of the experiment, the asset terminates worthless. The distribution of the dividends, the realized dividend payment in each period, and the current fundamental values are public information known to all subjects.

[2] We use adaptions to the original SSW markets as in Caginalp et al. (2001) that have also been used in another study looking at the effect of emotions on asset prices (Andrade et al., 2016).

Nine subjects trade in each market. At the beginning of the experiment, one-third of the subjects is endowed with 1800 ECU and 1 share of the risky asset, one-third with 1440 ECU and 2 shares of the risky asset, and the other third with 1080 ECU and 3 shares of the risky asset. Each trading period lasts for 2 minutes. The trading screen shows subjects all current information on their shares and cash holdings. Trade takes place in an open order book market with all orders executed according to price and then time priority. Transaction prices are shown in real time on all subjects' screens. On this basis, subjects can submit new offers to buy or sell. For this, they type in their offers in the respective offers' sections ("Buying Offer" or "Selling Offer") and click on the corresponding button "Buying Offer" or "Selling Offer". Additionally, there is the option to accept the best offers in the market by clicking on the "Buy" or "Sell" buttons. The best possible offers available in the market, i.e., the lowest to buy and the highest to sell, are always displayed in the last row. Using computerized instructions (see Appendix A), we familiarize subjects with the market structure, trading rules, calculation of earnings, and the nature of the asset to be traded before they start trading. Subjects also practice trading in two trial periods before starting with the trading periods that determine their payment.

To test whether a higher sustainability level induces more positive emotions on the one hand and leads to higher prices and larger bubbles on the other hand, we manipulate the description of the company of which subjects trade the shares. We randomly allocate subjects to one of three treatment groups: the positive, neutral, or negative sustainability group. In the positive sustainability group, we tell subjects that the company has a high sustainability performance and has been assigned an excellent sustainability score. In the neutral sustainability group, subjects learn that the company has an average track record and has been assigned an average sustainability score. Finally, in the negative sustainability group, we tell subjects that the company has a low sustainability performance, resulting in a bad sustainability score. We use sustainability scores since investors often rely on such scores to draw a picture of companies' sustainability efforts. To make the scores comparable across treatments and understandable for subjects, we add a scale with all possible score ranges and the corresponding sustainability performance levels. We run thirteen sessions for each treatment.

For emotions to arise as a result of the company's sustainability degree, it is important that subjects believe that the company's sustainability performance is not just hypothetical.

To make the setting more realistic for subjects, we tie dividend payments from the asset that the subjects trade to actual real-world impact, thereby mirroring the company's effect in real life. Specifically, we commit to donate to UN-approved real-world greenhouse gas emissions reduction projects based on the dividends paid in the experiment. The reductions are measured in CO_2 equivalent tonnes. Conditional on the treatment, the amount donated is either increasing, independent, or decreasing in dividends. For the positive sustainability group, a dividend payment of 100 ECU increases the donations made by the researchers by one tonne. Correspondingly, for the negative sustainability group, a dividend payment of 100 ECU decreases the donations originally planned by the researchers by one tonne. In the neutral sustainability group, dividends do not have real-world consequences. We argue that if sustainability induces affect, then relating firms' dividends to real-world actions that directly have an impact on the environment would trigger different emotions between treatment groups and thus result in corresponding differences in prices. To ensure that our treatment does not cause unforeseen changes in behavior which are unrelated to the sustainability aspect, we restrict the information we provide on the company to only sustainability information and make the description consistent across treatments. The exact description of the company for the three treatment groups can be found in Appendix A.

Post-experimental Survey

After the trading is over, subjects are asked to conduct a post-experimental survey. The survey is aimed to fulfill four main purposes. First, we run a manipulation check to test whether subjects understood the task and our treatments. We ask them about the holding value in a certain period and their perception of the impact of the dividends paid as well as their stock purchases on the environment. Second, we elicit subjects' social preferences. To measure social preferences, we rely on the experimentally validated questions by (Falk et al., 2022). Third, we elicit subjects' perceived emotions on the company description,Finally, we run a cognitive reflection test following Toplak et al. (2014) to infer subjects' cognitive abilities and ask questions about their demographic characteristics.

Hypotheses

Based on previous work, we develop several hypotheses to test the relationship between sustainability, emotions, preferences, and asset prices. The first hypothesis tests whether

the positive sustainability treatment displays higher average price levels and higher deviations from fundamental values than the neutral and negative sustainability treatments. If this is the case, the positive sustainability treatment would show stronger bubble formation in our setting. We, therefore, test whether bubbles are larger and in the positive sustainability treatment compared to the other treatments. For that, we employ three different bubble measures that have been used in prior studies. We test the hypothesis using two-sample two-tailed t-tests with equal variances and two-sample Mann-Whitney U-tests by comparing the bubble measures of the positive sustainability treatment to those of the other two treatments.

Hypothesis 1:

A higher sustainability level leads to higher subsequent prices and stronger bubble formation.

We not only want to test whether higher sustainability levels lead to higher prices and stronger bubbles, but instead, want to identify the mechanisms behind the proposed effect. Hence, we test whether social preferences, which have been shown to influence investors' willingness to pay (WTP) for socially responsible investments (Riedl and Smeets, 2017b) and choices for sustainable assets (Bauer et al., 2021; Riedl and Smeets, 2017b), are related to our bubble measures and can thus (partially) explain the projected price differences. We, therefore, test whether a higher average social preference level in a market with a high-sustainability asset leads to greater bubbles. Additionally, we expect fewer bubbles in markets with a low sustainability asset and higher average social preferences. Our measure for social preferences is based on Falk et al. (2022) and comprises a weighted score of a self-assessment question for willingness to share without expecting anything in return and a hypothetical donation question. To test hypothesis 2, we run separate regressions for the positive and negative sustainability treatments with three different bubble measures as the dependent variables. The regressors are the average social preferences, female fraction, average age, and average score in the cognitive ability test in an experimental session.

Hypothesis 2a:

Higher social preferences on the part of the average trader are positively correlated with subsequent prices and bubbles measures - if the sustainability rating is high.

Hypothesis 2b:

Higher social preferences on the part of the average trader are negatively correlated with

subsequent prices and bubbles measures - if the sustainability rating is low.

We further explore emotions as another channel for the proposed price differences. Breaban and Noussair (2018) show that initial valence has an effect on subsequent price levels. We posit that higher sustainability levels induce more positive emotions that subsequently affect subjects' trading behavior, acting as a mediator. We ask participants in all treatments using a post-experimental survey to indicate their perceived emotions while reading the company's description on a Likert scale from 1 to 10, where 1 corresponds to "very bad," and 10 corresponds to "very good". To test the hypothesis, we compare participants' perceived emotions across treatments using two-sample two-tailed t-tests with equal variances and two-sample Mann-Whitney U-tests.

Hypothesis 3:

A higher sustainability level leads to a more positive emotional state.

Results

Our main research goal is to find out whether sustainability levels have asset price implications in an interactive market setting. As can be inferred from Figure 1, bubbles arise across all three treatments. This is in line with previous studies using the same SSW market specifications. However, bubble magnitudes differ across treatment groups. Importantly, higher sustainability levels lead to comparably higher prices than a neutral or negative sustainability level.

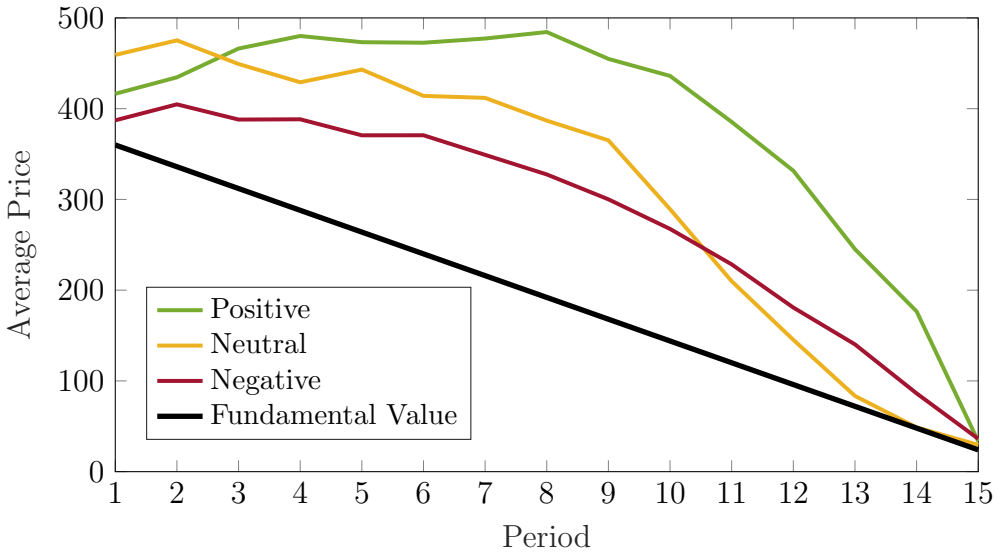


Figure 1: Average Price Paths

The figure plots the average prices by period for the positive, neutral, and negative sustainability treatments. The average transaction prices are plotted per period for thirteen markets in each treatment. The straight line depicts the declining fundamental value of the asset over the fifteen trading periods.

To examine the effects of the positive, neutral, and negative sustainability treatments, we use the magnitude of asset pricing bubbles as a measure for overpricing. We define the magnitude of bubbles as the relative deviation (RD) of the average price from the fundamental value and calculate it as follows: $RD = (1/N)\sum_{p=1}^{N}(P_p - FV_p)/\overline{FV}$, where P_p is the average transaction price in period p, FV_p is the fundamental value, i.e., expected holding value in period p, and $\overline{FV}$ is the average fundamental value over the life of the asset. Panel A of Table 1 reports the average RD across the three treatments. The average RD in the positive sustainability treatment (1.00) is greater than the average RD in the neutral (0.61) and negative sustainability (0.47) treatments. We test the differences between the treatments using two-sample Mann-Whitney-U tests and two-sample two-tailed t-tests with equal variances. Both tests yield that the average RD in the positive sustainability treatment is higher than in the neutral and negative sustainability treatments. We reject the null hypothesis RD (positive sustainability) = RD (neutral sustainability) with t=2.31, p<0.03 (t-test), and z= 1.87, p<0.07 (Mann-Whitney-U test). We reject the null-hypothesis RD (positive sustainability) = RD (negative sustainability) with t=3.56, p<0.01 (t-test), and z= 2.90, p<0.01 (Mann-Whitney-U test). We cannot reject the null hypothesis RD (neutral sustainability) = RD (negative sustainability) with t= 1.07, p<0.30 (t-test), and z= 0.85, p<0.40 (Mann-Whitney-U test).

Table 1: Bubble Measures by Treatment

Panel A: Relative Deviation			
Treatment	N	Mean	SD
Positive	13	1.00	0.46
Neutral	13	0.61	0.40
Negative	13	0.47	0.28
Panel B: Bubble Amplitude			
Positive	13	0.98	0.37
Neutral	13	0.78	0.32
Negative	13	0.53	0.22
Panel C: Upward Trend Duration			
Positive	13	3.23	2.45
Neutral	13	1.85	0.99
Negative	13	1.23	0.73

The table reports bubble measures across the three treatments. Relative deviation (RD) is defined as: $RD = (1/N)\sum_{p=1}^{N}(P_p - FV_p)/\overline{FV}$, where P_p is the average transaction price in period p, FV_p is the fundamental value, i.e., expected holding value in period p, and $\overline{FV}$ is the average fundamental value over the life of the asset. Bubble amplitude is defined as: $Amplitude = max_p\{(P_p - FV_p)/FV_1\} - min_p\{(P_p - FV_p)/FV_1\}$ and upward trend duration is defined as: $Duration = max\{m : P_p < P_{p+1} < ... < P_{p+m}\}$.

We additionally report results on two other commonly used measures in previous literature[3], namely bubble amplitude and upward trend duration to capture the differences between the treatments' price paths in more detail. Bubble amplitude measures the magnitude in price changes relative to the fundamental value from the period with the lowest overpricing to the period with the highest overpricing. Accordingly, $Amplitude = max_p\{(P_p - FV_p)/FV_1\} - min_p\{(P_p - FV_p)/FV_1\}$, where P_p and FV_p equal the average transaction price and fundamental value in period p, respectively. Panel B of Table 1 reports the average bubble amplitude across the three treatments. For both tests, we find that bubble amplitude is significantly higher in the positive sustainability treatment compared to the negative sustainability treatment. We reject the null hypothesis *Amplitude* (positive sustainability) = *Amplitude* (negative sustainability) with t= 3.72, p<0.01 (t-test), and z= 2.72, p<0.01 (Mann-Whitney-U test). We cannot reject the null hypothesis *Amplitude* (positive sustainability) = *Amplitude* (neutral sustainability) with t= 1.49,

[3]see for example: Hussam et al. (2008); Kirchler et al. (2012); Haruvy et al. (2007)

p< 0.15 (t-test), and z= 1.33, p<0.18 (Mann-Whitney-U test). In contrast to the relative deviation, for both tests we see that bubble amplitude is significantly higher in the neutral sustainability treatment compared to the negative sustainability treatment. We reject the null hypothesis *Amplitude* (neutral sustainability) = *Amplitude* (negative sustainability) with t= 2.27, p<0.04 (t-test), and z= 1.78, p<0.08 (Mann-Whitney-U test).

Upward trend duration measures each market's number of consecutive periods in which there is an increase in market prices from one period to the next. Specifically, $Duration = max\{m : P_p < P_{p+1} < ... < P_{p+m}\}$. Panel C of Table 1 reports the average upward trend duration across the three treatments. For both tests, we find that upward trend duration is significantly higher in the positive sustainability treatment compared to the neutral and negative sustainability treatments. We reject the null hypothesis *Duration* (positive sustainability) = *Duration* (negative sustainability) with t= 2.82, p<0.01 (t-test), and z= 2.98, p<0.01 (Mann-Whitney-U test). We reject the null hypothesis *Duration* (positive sustainability) = *Duration* (neutral sustainability) with t= 1.89, p< 0.08 (t-test), and z= 1.81, p<0.07 (Mann-Whitney-U test). We can reject the null hypothesis *Duration* (neutral sustainability) = *Duration* (negative sustainability) according to the two-tailed t-test with t= 1.81, p<0.09 (t-test), but not according to the Mann-Whitney-U test with z= 1.44, p<0.15.

In summary, the results on our main bubble measure, the relative deviation from fundamental values, demonstrate that the positive asset is more prone to overpricing than the neutral and negative one. When looking at bubble amplitude, we can further assess how the negative asset is priced. The significant differences in bubble amplitudes between the positive and the negative, as well as the neutral and the negative treatment underline that in the negative treatment group, prices do not experience price changes as extreme as in the other treatment groups, which is in line with a less risk-seeking trading environment. Although we cannot find differences in maximum price changes between the positive and neutral asset, the results on the upward trend duration and relative deviation emphasize that overpricing perseveres longer in the positive treatment group. Specifically, the results on the upward trend duration indicate that the greener the asset, the longer people are willing to increasingly overpay for it. Importantly, the average transaction prices still also converge to zero for the green asset at the end of the experiment.

We now examine whether investors' social preferences are correlated with the bubble measures in the different treatments. We control for the following average group charac-

teristics: gender, age, and cognitive ability. We find support for hypothesis 2a. Table 2 shows that the higher the average social preferences in the market, the larger the bubbles, if the asset traded is highly sustainable. Notably, the effect is consistent across the three bubble measures. Higher social preferences are correlated with higher overpricing, higher maximum price changes, and longer upward trends for the green asset. Thus, individuals with higher social preferences seem to contribute more to driving up the prices of assets that align with their values. This result can be interpreted as investors with higher social preferences exhibiting a higher WTP for sustainable investments, which is manifested in the size of bubbles in our setting.

We do not find support for hypothesis 2b. Social preferences are not correlated with the magnitude of bubbles in the negative sustainability treatment. Thus, while higher social preferences are correlated with stronger bubbles when the asset exhibits high sustainability, an equivalent relationship does not apply for assets with low sustainability as socially responsible investors do not seem to drive down their prices. Again this observation is consistent across all bubble measures. Further, results remain qualitatively the same if we investigate the link between average social preferences and average transaction prices instead of the bubble measures for all treatments.

Besides social preferences, the fraction of female traders in a market affects the size of bubbles when the asset traded is sustainable. The positive coefficients on all three bubble measures in Columns (1)-(3) of Table 2 suggest that the higher the fraction of female traders in a market, the larger the bubbles, given that the asset is highly sustainable. Prior literature findings show that women have stronger social preferences than men (Eckel and Grossman, 1998; Güth et al., 2007) and there is evidence that they are more likely to invest responsibly (Brodback et al., 2019; Gutsche et al., 2023). Since we control for social preferences, the relationship between the female fraction and the bubble strength must go beyond the channel of social preferences. This result is striking since prior literature documents an inverse relationship between the fraction of female traders and the magnitude of bubbles (Eckel and Füllbrunn, 2015). Thus, our findings show that female traders seem to be more strongly affected by the sustainable character of the asset, leading them to contribute to higher prices despite their risk-averse nature. On the other hand, Columns (4)-(6) indicate that the fraction of female traders does not impact overpricing if the asset is not sustainable, suggesting that females only react more strongly to positive but not negative sustainability information.

We infer that social preferences and gender show similarities when it comes to the relationship with overpricing in the positive and negative sustainability treatments. While both characteristics are positively correlated with the size of bubbles when the asset is sustainable, they do not have an effect on bubbles when the asset is not sustainable.

Table 2: Relationship between Social Preferences and Bubble Measures

	Positive			Negative		
	(1) RD	(2) Amplitude	(3) Duration	(4) RD	(5) Amplitude	(6) Duration
Social Preferences	1.069***	0.953***	8.842**	0.443	0.171	-0.633
	(0.157)	(0.167)	(2.995)	(0.261)	(0.284)	(1.337)
Female	2.814***	1.818**	19.28**	-0.234	-0.521	0.409
	(0.678)	(0.618)	(7.066)	(0.470)	(0.411)	(1.971)
Age	0.0345	0.0798	-0.864	0.0441	0.0531	-0.0420
	(0.0573)	(0.0635)	(0.638)	(0.0603)	(0.0636)	(0.228)
CRT	-0.472	-0.170	15.56	-2.204**	-1.777*	-1.154
	(1.015)	(0.968)	(8.569)	(0.778)	(0.895)	(3.262)
Constant	-1.381	-1.959	2.540	0.847	0.602	2.686
	(0.780)	(1.077)	(7.588)	(1.513)	(1.746)	(6.049)
Observations	13	13	13	13	13	13
R^2	0.762	0.707	0.697	0.673	0.562	0.075

The table presents OLS regressions for the three bubble measures on investors' social preferences for the three treatment groups. The dependent variables are *RD*, *Amplitude*, and *Duration*, respectively. The independent variable *Social Preferences* depicts the average social preference level in an experimental session and is calculated based on Falk et al. (2022) as the weighted score on the questions "How do you assess your willingness to share with others without expecting anything in return?" and a hypothetical donation question. The variable is standardized. We use the averaged demographics *Age*, *Female*, and *CRT* as controls. Standard errors are in parentheses. The significance levels are denoted as: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

To further uncover the mechanisms behind the effect of sustainability information on asset prices and bubble magnitude, we also compare the emotions that arise in the different treatment groups. For the analysis of differences in emotions across treatments, we use data from the post-experimental survey. In this survey, we ask subjects about their emotional state while reading the company's description on a Likert scale from 1 to 10, where 1 corresponds to "very bad," and 10 corresponds to "very good". Table 3 reports the average perceived emotions across the three treatments. The average perceived emotions in the positive sustainability treatment (7.41) are higher than in the neutral sustainability treatment (5.45), and higher than those in the negative sustainability treatment (3.96). We again test the differences between treatments using two-sample, two-tailed t-tests

with equal variances, and Mann-Whitney-U tests. Subjects in the positive sustainability group feel more positive about the company description compared to subjects in the neutral and negative sustainability groups. Moreover, subjects in the negative sustainability group report feeling worse about the company description relative to subjects in the neutral group. We reject the null hypothesis perceived emotions (positive sustainability) = perceived emotions (neutral sustainability) with t= 8.46, p<0.01 (t-test), and z= 7.52, p<0.01 (Mann-Whitney-U test). We reject the null hypothesis perceived emotions (positive sustainability) = perceived emotions (negative sustainability) with t= 13.33, p<0.01 (t-test), and z= 10.274, p<0.01 (Mann-Whitney-U test). Finally, we reject the null hypothesis perceived emotions (negative sustainability) = perceived emotions (neutral sustainability) with t= 6.57, p<0.01 (t-test), and z= 7.52, p<0.01 (Mann-Whitney-U test).

Table 3: Perceived Emotions by Treatment

Treatment	N	Mean	SE
Positive	117	7.41	0.19
Neutral	117	5.45	0.14
Negative	116	3.96	0.18

The table reports subjects' perceived emotions while reading the company description's text across the three treatments. The answers are based on the question "How did you feel while reading the company description? on a Likert scale from 1 to 10, where 1 corresponds to "very bad," and 10 corresponds to "very good".

The results on emotion levels across treatments are in line with the differences in bubble sizes being influenced by the affect heuristic. Subjects feeling more positive about the company they trade the shares of in the positive sustainability group thus explain the larger bubbles we observe in this group compared to the two other groups. The positive emotions that arise in the positive sustainability group are expected to trigger risk-taking behavior, therefore leading subjects to drive up prices comparably high. Further, subjects exhibiting more negative emotions in the negative sustainability group is in line with our observation of the largest difference in bubble measures between the positive and negative treatment groups. Our results support the findings of studies that document an effect of emotions on subsequent prices and bubbles (Andrade et al., 2016; Breaban and Noussair, 2018).

For the following analyses, we use emotion levels that we obtained using the face-reading software. We average the trading periods' emotions data over each 10-second interval τ, which means that we average 300 observations (we obtain 30 data points for each second) for every 10-second interval. This procedure is in line with Breaban and Noussair (2018).

We analyze how participants' emotions change as a reaction to their own pricing decisions across treatments. Specifically, we investigate how people's valence levels adapt after they choose to purchase the asset at a high price relative to its fundamental value (overpaying[4]). Additionally, we assess whether people become more fearful after selling the asset for a low price relative to its fundamental value (underselling[5]). Table 4 shows that participants generally feel negatively about overpaying for an asset.[6] At the same time, people seem to be much more content with their decisions to overpay for the asset if it is sustainable. This result could be driven by affect, but also by people anticipating following price increases or their preferences for owning the asset. We do not observe a general effect of underselling decisions on subsequent fear levels. However, we do see that if the asset is unsustainable, participants experience lower subsequent levels of fear as a reaction to having sold the asset at a low price. This result could again be driven by affect, but also by people expecting following price decreases or their distaste for the asset. Moreover, our results indicate that higher price levels lead to lower valence if the asset is sustainable and lower fear if the asset is unsustainable. Since the regression only incorporates those observations where a participant bought or sold the asset, this would suggest that participants feel worse about high price levels in the positive sustainability treatment since they want to own or purchase the asset. Consequently, participants are less fearful of high prices if the asset is unsustainable since they want to sell the asset.

[4]Overpaying$_\tau$ is defined as the average purchase price minus the fundamental value times the number of assets bought in each 10-second interval.

[5]Underselling$_\tau$ is defined as the fundamental value minus the average sales price times the number of assets sold in each 10-second interval.

[6]Price level is defined as the deviation of the most current transaction price from the fundamental value. Price level thereby controls for the overvaluation of the asset. Price Change is defined as the deviation of the current mid price from the average price within the previous period. Price change thereby approximates the strength of boom and bust phases.

Table 4: The Effect of Overpaying and Underselling on Valence and Fear

	(1) Valence$_{\tau+1}$	(2) Fear$_{\tau+1}$
Valence$_\tau$	0.516***	
	(0.0451)	
Overpaying$_\tau$	-0.0000873**	
	(0.0000435)	
Positive × Overpaying$_\tau$	0.000274***	
	(0.0000844)	
Negative × Overpaying$_\tau$	-0.0000387	
	(0.000134)	
Fear$_\tau$		0.421***
		(0.0621)
Underselling$_\tau$		0.00000872
		(0.00000904)
Positive × Underselling$_\tau$		-0.0000145
		(0.0000129)
Negative × Underselling$_\tau$		-0.0000303**
		(0.0000152)
Cash Holdings$_\tau$	-0.00000221	-0.000000402
	(0.00000585)	(0.00000151)
Asset Holdings$_\tau$	-0.00107	-0.000269
	(0.00245)	(0.000500)
Price Change$_\tau$	-0.0000121	-0.00000676
	(0.0000416)	(0.00000800)
Price Level$_\tau$	0.0000635	0.00000884
	(0.0000546)	(0.00000865)
Positive × Price Level$_\tau$	-0.000185*	-0.0000150
	(0.0000989)	(0.0000131)
Negative × Price Level$_\tau$	0.0000547	-0.0000262*
	(0.000134)	(0.0000153)
Constant	-0.0592***	0.0108***
	(0.0143)	(0.00315)
Observations	2,321	2,338
R^2	0.243	0.195

This table presents the OLS regression with subjects' fixed effects of valence and fear in the next 10-second interval τ on overpaying and underselling. We use cash holdings, asset holdings, mean price level, and price change in the current 10-second interval as controls. *Positive* and *Negative* correspond to the positive, and negative sustainability treatments. The interaction terms for the neutral treatment are omitted. Standard errors are clustered on subject level. Standard errors are in parentheses. The significance levels are denoted as: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

To find out whether the emotions triggered by the sustainability information also lead to price changes, we now investigate how emotions affect participants' trading behavior across treatments. Specifically, we focus on the relation of valence and fear with the number of units participants decide to buy or sell. Each activity is coded at the time at which each individual places or accepts bids and asks. Table 5 suggests that valence is generally negatively correlated with the willingness to sell the asset, while fear is generally associated with a higher willingness to sell the asset, as indicated by the coefficients on the number of units sold [7]. Moreover, the relation between valence and the willingness to sell is less negative in the negative sustainability treatment compared to the baseline. This implies that participants would still want to sell the unsustainable asset despite experiencing positive emotions. Similarly, the relationship between fear and the willingness to sell is smaller in the positive sustainability treatment. We find no significant relationship between the number of units bought[8] and emotions and no differences in this relationship across treatments.

We show that sustainability information leads to emotional reactions from participants and that sustainability information influences prices. At the same time, we observe that there is a relationship between emotions and trading activity. However, we only observe this relationship for sale, not purchase decisions, and it is partially mitigated by the sustainability level of an asset. This suggests that people experience a higher level of consciousness in their decision-making when choosing to purchase or sell (un)sustainable assets, which highlights the role of demographics, such as social preferences and gender, in price differences across treatments, as was shown in Table 2. However, we must note that participants experience heightened levels of emotions when sustainability information is included. In summary, our results indicate that tastes, as well as emotions, play a role in the price differences across treatments.

[7] $Units\ Sold_\tau$ is the amount of ask orders placed and buying orders accepted in each 10-second interval.
[8] $Units\ Bought_\tau$ is the amount of bid orders placed and selling orders accepted in each 10-second interval.

Table 5: The Effect of Valence and Fear on Purchases and Sales

	(1) Units Bought$_\tau$	(2) Units Sold$_\tau$	(3) Units Bought$_\tau$	(4) Units Sold$_\tau$
Valence$_{\tau\text{-}1}$	-0.600	-1.126***		
	(0.379)	(0.266)		
Positive × Valence$_{\tau\text{-}1}$	0.377	0.650		
	(0.498)	(0.404)		
Negative × Valence$_{\tau\text{-}1}$	0.502	1.158***		
	(0.479)	(0.408)		
Fear$_{\tau\text{-}1}$			1.294	2.761***
			(1.207)	(0.861)
Positive × Fear$_{\tau\text{-}1}$			-0.804	-7.174***
			(1.905)	(2.186)
Negative × Fear$_{\tau\text{-}1}$			-3.998	-2.349
			(2.495)	(2.084)
Cash Holdings$_{\tau\text{-}1}$	0.000568***	-0.000340***	0.000577***	-0.000332***
	(0.000207)	(0.000108)	(0.000206)	(0.000114)
Assets Holdings$_{\tau\text{-}1}$	-0.0476	0.171***	-0.0449	0.175***
	(0.0754)	(0.0446)	(0.0748)	(0.0461)
Price Change$_{\tau\text{-}1}$	0.000184	0.00168***	0.000188	0.00168***
	(0.000404)	(0.000369)	(0.000407)	(0.000370)
Price Level$_{\tau\text{-}1}$	-0.00107***	-0.000642**	-0.00107***	-0.000647**
	(0.000279)	(0.000260)	(0.000279)	(0.000261)
Observations	45,042	45,222	45,042	45,222

This table presents a Poisson count regression with subject-fixed effects of participants' purchases and sales on valence and fear in the previous 10-second interval τ. We use cash holdings, asset holdings, mean price level, and price change in the previous 10-second interval as controls. *Positive* and *Negative* correspond to the positive, and negative sustainability treatments. The interaction terms for the neutral treatment are used as a baseline and therefore omitted. All specifications use robust standard errors. Standard errors are in parentheses. The significance levels are denoted as: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Discussion and Conclusion

We study the pricing of (un)sustainable assets in an interactive market setting and explore social preferences and emotions as potential channels. According to our knowledge, this is the first study that directly tests the effect of sustainability on asset prices in an experimental market setting. We observe that receiving positive information about the sustainability of a firm results in higher prices compared to receiving neutral or negative information. When uncovering potential mechanisms for these price differences, we find evidence for both social preferences and emotions playing a role in pricing sustainable assets.

Following prior studies documenting the importance of social preferences for sustainable investment decisions (e.g. Riedl and Smeets, 2017b; Bauer et al., 2021), we examine the role of social preferences in our setting and find that social preferences are correlated with our pricing measures. Specifically, we observe that the higher the social preferences on the part of the average trader, the higher the overpricing in the positive sustainability treatment. The relationship is consistent across three different asset-pricing measures. This finding suggests that traders are more willing to overpay for an asset if it aligns with their social values, corroborating earlier findings on investors' WTP for sustainable investments. Moreover, we document another interesting relationship between investors' demographics and asset pricing. Notably, we find the fraction of female traders in a market to be associated with the magnitude of overpricing. Particularly, female traders contribute to more overpricing when the asset is highly sustainable, an observation that is again persistent across different measures. Thus, the commonly observed risk-averse attitude of female traders appears to be reversed as a result of the sustainable character of the traded asset. These results underscore the importance of demographics for the willingness to (over)pay for sustainable assets and demonstrate a channel for the observed pricing effects. Further, the findings imply that the proportion of investors with high social preferences and female traders might stimulate overpricing of sustainable assets in financial markets.

Turning to our second channel, emotions, we use face-reading software to capture participants' emotional states throughout the experiment. We believe that measuring subjects' emotions using face-reading software provides a more accurate measure compared to self-reported emotions, allows for the measurement of the effect of emotions at the exact time that they arise, and thus provides more reliable insights about the underlying mecha-

nism. We additionally examine participants' perceived emotions upon reading the firm's description using a survey and use them to test differences in emotional reactions to our treatments. We observe differences in emotions based on the sustainability character of the asset traded. Investors experience more positive emotions when the underlying asset is sustainable, while the opposite holds for an unsustainable asset. Prior literature shows that emotions affect asset prices (Andrade et al., 2016; Breaban and Noussair, 2018) and recent evidence highlights its role in sustainable investment decisions (Hartzmark and Sussman, 2019; Heeb et al., 2022; Merkle, 2022). Since we observe a change in emotions as a response to the exposure to different sustainability information, we further investigate whether emotions can also partially explain price differences.

It is important to note that our real-time trading data allows us to infer insights from investors' trading behavior that help further identify the mechanisms behind the observed price differences. Specifically, investors' emotional reactions to their own trading decisions as well as the interaction between their current emotions and subsequent trading activity, provide an opportunity to analyze whether emotions serve as an explanatory factor for the underlying price effects of sustainability. We observe that investors react more positively to overpaying for a sustainable asset and exhibit less fear upon underselling an unsustainable asset. These findings could reflect investors' preferences or distaste for high and low sustainability, respectively. Regarding trading activity, our results suggest that, while limited, emotions do have an effect on trading behavior. Particularly, we find that emotions affect sale decisions, but not purchase decisions and that the underlying effect is alleviated by the asset's sustainability level. We interpret this finding as indicating that sustainability decreases the sensitivity of sale decisions to changes in emotions, thus suggesting higher awareness levels when sustainability factors are involved.

Our findings provide support for the role of affect in investment decisions (Finucane et al., 2000; Slovic et al., 2005, 2007). Specifically, we provide evidence that emotions that investors collectively associate with an asset affect their trading behavior and asset prices. Our study is different from other experimental studies on emotions and asset pricing in the sense that emotions are not induced exogenously but are linked to asset characteristics. Further, our study contributes to the literature showing that investors value sustainability (Hartzmark and Sussman, 2019) and that their social preferences explain their sustainable investment decisions (e.g. Riedl and Smeets, 2017b; Bauer et al., 2021).

Our results have important policy implications. Policymakers should take into account how the reporting of firms' sustainability information might affect investors' WTP for and, thus, the pricing of respective assets. It is important that investors are fully aware of the true sustainability efforts of firms to be able to make informed decisions. This underscores the vitality of transparency regarding sustainability information reporting. Thus, policy efforts aiming at standardization and the alignment of reported and real sustainability levels are extremely important so that investments flow into the right firms, harnessing the potential for solving societal and environmental challenges.

Appendix A: Instructions

A.1 General Instructions

Thank you for your participation. Please note that you are being videotaped and that only the researchers involved in the experiment will have access to these videos. We kindly ask you to avoid any interaction with other participants for the duration of the experiment. If you face any difficulties, contact one of the supervisors. After the experiment, you will be paid for your participation via bank transfer or PayPal. Your earnings depend on your decisions and the decisions of the other participants.

The experiment consists of a sequence of trading Periods in which you will have the opportunity to buy and sell in a market. The currency used in the market is ECU. All trading will be done in terms of ECU. The final payment to you at the end of the experiment will be in euros. The conversion rate is: **200 ECU to 1 euro**

A.2 Market Description

The goods that can be bought and sold in the market are called Shares. You are given **Cash** and **Shares** at the beginning of the experiment. You can use your cash to buy shares and you earn cash when you sell shares. Everyone in the market can buy and sell shares.

Nine of the participants present here each trade in a market:

- **3 traders** are initially endowed with **1800 ECU and 1 share**
- another **3 traders** are endowed with **1440 ECU and 2 shares**
- the remaining **3 traders** are endowed with **1080 ECU and 3 shares**

The allocation is **random**.

At the beginning of the experiment the asset has a **holding value of 360** ECU. On the next pages, the holding value will be explained in more detail. Evaluating the asset at its initial holding value yields that **all subjects have the same initial wealth** which is equal to 2160 ECU. The trading lasts for **15 Rounds** and each round automatically terminates after **two minutes**. Your cash and share holdings are always transferred to the next round.

When you own a Share, you earn cash on it in form of a **Dividend**. Companies pay dividends as a means of sharing their profits with their shareholders. At the end of each round, **EACH share** will **pay the owner a dividend** . The dividend on the share can be

- **0 ECU with a chance of 25%**
- **8 ECU with a chance of 25%**
- **28 ECU with a chance of 25%**
- **60 ECU with a chance of 25%**

Each of the four values for the dividend is equally likely. Therefore, the **average dividend** in **each period** is **24 ECU** . The dividends **go automatically into your cash earnings**.

You do not know the dividends of the current or next periods. At the end of a period, you will be informed about the dividend realized in the expired period.

Given that the trading lasts 15 rounds, the **holding** value per share at the beginning of the experiment is equal to **360 ECU (15x24)**.

After the dividend is paid at the end of period 15, there **will be no further earnings possible from shares**. That is, the shares **worth nothing**.

A.3 Earnings

Your earnings are **equal to the cash** you have at the **end of period 15** after the last dividend is paid. Your cash at the end of the experiment is equal to:

- **your money at the beginning** of the experiment
- **+ dividend payments**
- **+ money received** from **selling** shares
- **- money spent** on **buying** shares.

A.4 Average Holding Value Table

You can use your AVERAGE HOLDING VALUE TABLE to help you make decisions. There are 5 columns in the table. The first column, labeled Ending Period, indicates the last trading period of the experiment. The second column, labeled Current Period, indicates the period during which the average holding value is being calculated. The third column gives the number of holding periods from the period in the second column until the end of the experiment. The fourth column, labeled Average Dividend per Period, gives the average amount that the dividend will be in each period for each unit held in your inventory. The fifth column, labeled Average Holding Value Per Unit of Inventory, gives the average value for each unit held in your inventory from now until the end of the experiment. That is, for each share you hold for the remainder of the experiment, you will earn on average the amount listed in column 5.

Suppose for example that there are 7 periods remaining. Since the dividend on a Share has **a 25% chance of being 0, a 25% chance of being 8, a 25% chance of being 28 and a 25% chance of being 60 ECU** in any period, the **dividend is on average 24 ECU** per period for each Share. If you hold a Share for the remaining 7 periods, the total dividend for the Share over the 7 periods is on average 7*24 = 168. Therefore, the total value of holding a Share over the 7 periods is on average 168.

As you see in the table, **the average holding value of a Share decreases each period until it becomes 0 after period 15**. The average holding value of the Share **becomes less in each period by the amount of the expected dividend** which is **24**. When the Share has paid all of its dividends at the **end of the experiment, it becomes worthless**.

A.5 How to use the computerized market

Within each round, participants can buy or sell shares from one another by making and accepting offers to buy or to sell. To make an Offer to Buy, you enter the buying price into the blue field "Buying Offer" and click on the red button "Buying Offer". To make an Offer to Sell, you enter the selling price into the blue field "Selling Offer" and click on the red button "Selling Offer". Your own offer is listed in blue while the offers of others are listed in black. Submitting a second offer will replace your outstanding previous offer. Thus, you can replace an offer that you have made by simply submitting a new offer. Note that you can only enter integers. Offers to Buy are listed under "Buying Offers" and Offers to Sell are listed under "Selling Offers". Offers to Buy will be listed in increasing order,

while Offers to Sell will be listed in decreasing order. Each offer is made for a **single share**. You can make and accept as many offers as you want in each period as long as your money and shares do not drop below zero.

In the exemplary illustrated auction below, the Offers to Buy are 200, 300, and 350, Offers to Sell are 600, 500, and 400 currency units. Note that the prices here are arbitrarily chosen and are irrelevant to the actual prices that will happen in the experiment. When you buy a share, your Money decreases by the price of the purchase and the number of your shares increases by one. When you sell a share, your Money increases by the price of the sale and the number of your shares decreases by one. To accept a Buying Offer, you need to select the offer under "Buying Offers" and click "Sell". To accept a Selling Offer, you need to select the offer under "Selling Offers" and click "Buy". You can select an offer by clicking on it. It will then be highlighted. In the exemplary auction below, the highest buying price of 350 is selected by the seller and marked blue. Once an offer is accepted, it is listed under "Trading Prices" with the accepted price.

You will have two trial periods that last two minutes each. The only goal of the practice period is to master the use of the interface. Please be sure that you have successfully submitted offers to buy and offers to sell. Also be sure that you have accepted buy and sell offers. If you have any questions, please raise your hand and the instructor will come by and assist you.

A.6 Company Descriptions

A.6.1 Positive Treatment

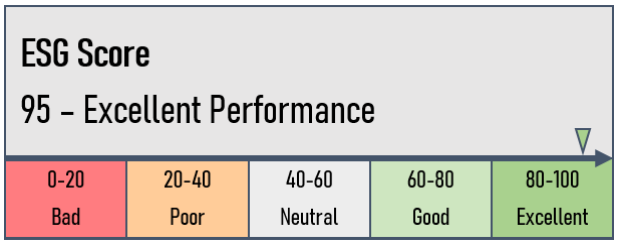
The shares that you trade are of a fictitious company X which has been assigned a sustainability score. Company X has a sustainability score of 95 which means that it is considered a **leader** in its industry in managing the most significant sustainability issues and opportunities.

Company X's operations are good for the environment since it has a long history of supporting climate action and complements each dividend payment with an investment in greenhouse gas reduction projects. To actualize company X's impact on the environment in this experiment, company X's actions will translate into **real world investments in greenhouse gas removal projects** that have been approved by the United Nations (UN). The UN offers a platform where one can purchase units (carbon credits) to compensate greenhouse gas emissions. The proceeds from the carbon credit purchases

are invested in projects that lead to a certified reduction of greenhouse gas emissions, measured in CO_2 equivalent tonnes.

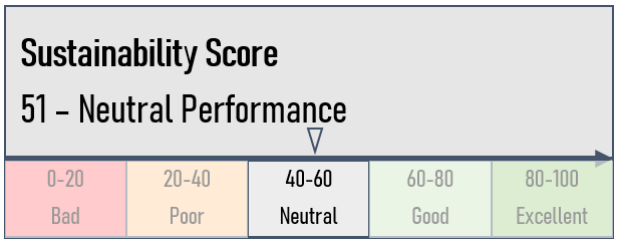
With each dividend payment, we, the researchers **buy** carbon credits from the UN for the support of projects that reduce greenhouse gas emissions. The **higher** the dividends, the **higher** our donations for the reduction of greenhouse gases. In other words, the **higher** the dividends, the **better** the effect on the environment. **The donations are independent of the number of shares you hold**. A total dividend payment of 100 ECU corresponds to an **increase** of the carbon offset donations by **one tonne** (For comparison, this would be equivalent to planting 6 trees). Accordingly, a dividend payment of for example 28 ECU would lead to a **carbon reduction** of 0.28 tonnes.

The donations will be made by the researchers after the experiment and do not affect your final earnings. You will be sent an e-mail with the certificate documenting the greenhouse gas emission reductions we undertake in this experiment to mirror company X's positive real life impact.



A.6.2 Neutral Treatment

The shares that you trade are of a fictitious company X which has been assigned a sustainability score. Company X has a sustainability score of 51 which means that it has an **average track record** of managing the most significant sustainability issues and opportunities relative to industry peers.



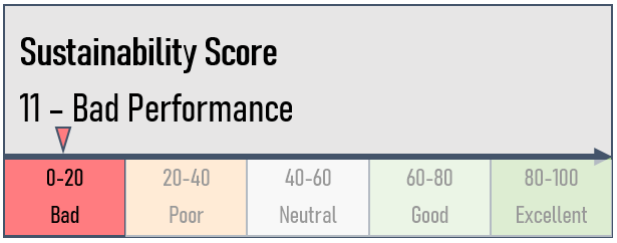
A.6.3 Negative Treatment

The shares that you trade are of a fictitious company X which has been assigned a sustainability score. Company X has a sustainability score of 11 which means that it is lagging its industry based on its **high exposure and failure to manage significant sustainability issues**.

Company X's operations are bad for the environment since it releases a lot of carbon dioxide during production. The more profitable company X is, the more CO_2 is emitted into the environment. To actualize company X's impact on the environment in this experiment, donations are deducted from a donation account whose **remaining balance** the researchers will invest into United Nations (UN) approved greenhouse gas removal projects after the experiment. The UN offers a platform where one can purchase units (carbon credits) to compensate greenhouse gas emissions, measured in CO_2 equivalent tonnes.

With each dividend payment, we, the researchers **deduct** carbon credits from the donation account. The **higher** the dividends, the **lower** our greenhouse gas offset donations. In other words, the **higher** the dividends, the **worse** the effect on the environment. **The donation deductions are independent of the number of shares you hold**. A total dividend payment of 100 ECU corresponds to a **decrease** of the offset donations by **one tonne** (For comparison, this would be equivalent to cutting 6 trees). Accordingly, a dividend payment of for example 28 ECU would lead to a **donation reduction** corresponding to 0.28 tonnes. The initial donation sum corresponds to 6 tonnes of greenhouse gas offsets.

What is left of the initially planned donations after all dividends are paid will be transacted by the researchers after the experiment and does not affect your final earnings. You will be sent an e-mail documenting how much we could still donate for CO_2 emissions reductions and how much we had to cut from the initially planned donations to mirror company X's negative real life impact.



Appendix B: Questionnaire

B.1 Demographics

1. What is your age?

2. What is your gender?

B.2 Social Preferences and Climate Awareness

1. Imagine the following situation: Today you unexpectedly received 1,000 Euro. How much of this amount would you donate to a good cause? (Integers between 0 and 1,000 are allowed)

2. How do you assess your willingness to share with others without expecting anything in return? (1 = Completely unwilling to share. 10 = Very willing to share.

3. How much do you agree with the following statement: Climate change is a serious problem that concerns me deeply. (1= I do not agree at all. 10 = I agree completely.)

4. How much do you agree with the following statement: Carbon offset projects make a difference and can help protect our planet. (1 = I do not agree at all. 10 = I agree completely.)

B.3 Cognitive Reflection Test

1. If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together?

2. Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class?

3. A man buys a pig for 60 Euro, sells it for 70 Euro, buys it back for 80 Euro, and sells it finally for 90 Euro. How much has he made?

4. Simon decided to invest 8,000 Euro in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has: a. broken even in the stock market, b. is ahead of where he began, c. has lost money.

B.4 Perceived Emotions

1. How did you feel while reading the company description? (1 = Very bad. 10 = Very good.)

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