Do markets encourage risk-seeking behaviour?*

Friederike Mengel [†] Ronald Peeters[‡]
University of Essex University of Otago
Lund University

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Abstract

Excessive risk-taking in markets can have devastating consequences as the latest financial crises have highlighted. In this paper we ask whether markets as an institution encourage such excessive risk-taking. To establish causality, we isolate the effects of market interaction in a laboratory experiment keeping other possibly confounding factors constant. We find that the opposite is true. Markets decrease participants' willingness to take risks. This finding can be explained by social comparison utility in the presence of negatively correlated risks.

Keywords: Markets; Risk-taking; Social comparison; Experiment.

JEL Classification Numbers: D02; D03; C92.

[†]Department of Economics, University of Essex, Wivenhoe Park, Colchester CO4 3SQ *and* Department of Economics, Lund University, SE-220 07 Lund, Sweden. *e-mail*: fr.mengel@gmail.com.

[‡]Department of Economics, University of Otago, PO Box 56, Dunedin 9054, New Zealand. *e-mail*: ronald.peeters@otago.ac.nz.

1   Introduction

Markets are ubiquitous in modern society (North, 1991). We interact in markets to trade goods, services and information and they affect most aspects of our everyday life. Markets have been praised for their ability to efficiently aggregate expectations and information from disparate traders, thereby allocating resources more efficiently than central authority and governments (Hayek, 1945). However, there seem to be downsides as well. Evidence that market interactions may go along with the risk of moral decay has recently been the subject of a keen debate in politics, ethics and in the social sciences, including economics (Shleifer, 2004; Falk and Szech, 2013; Bartling et al., 2015). One particular aspect of moral hazard that received increasing attention during the latest economic crisis is that incentives provided by markets may encourage risk-taking behaviour (Bernanke, 2008; Porcelli and Delgado, 2009; Dong et al., 2010).

In this study, we investigate whether markets induce risk-taking behaviour. The ideal experiment to identify a causal effect of markets on risk-taking behaviour involves the comparison of different institutions at the same time in identical, but distinct societies with no interactions or feedback effects between them. To come as close as possible to this ideal, we conducted a laboratory experiment in which we randomly assign subjects to different institutional environments. In treatments with market interaction (the market treatments) assets are traded via a call auction mechanism (Plott and Smith, 2008). In the non-market treatments prices of assets are determined via a Becker-de Groot-Marschak (BDM) mechanism (Becker et al., 1964). In all treatments two assets are traded in parallel markets, where one asset is more risky than the other in the sense of mean-preserving spreads. Risk-taking behaviour is measured by the difference in the prices of these two assets. We find that markets *decrease* participants' willingness to take risks. Hence, while excessive risk-taking is frequently observed in markets, markets do not appear to be causal to such behaviour. Our findings can be explained by social comparison utility in the presence of negatively correlated risks.[1]

Our results contribute to two different strands of literature. The first concerns the literature focusing on how social comparison affects behaviour in market settings. Oechssler et al. (2011) and Schoenberg and Haruvy (2012) found that information and communication among traders affect the prevalence of price bubbles in experimental asset markets. A number of field studies using information on social ties or the spatial distribution of traders, including Hong et al. (2005) and Bursztyn et al. (2014), provided evidence that peer decisions matter for stock market participation and trading decisions. Finally, within a portfolio choice setting designed to test the Arrow-Debreu predictions on risk-sharing, Gortner and van der Weele (2019) find that both imitation and positional preferences play a role for risk-taking. Un-

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[1]When two traders exchange a risky asset at a (market) price, the buying trader's holdings increase in riskiness, while that of the selling trader decreases. Whereas our market treatments are characterised by such exchanges, our non-market treatments are not, since traders can be buying and selling without there being an explicit trading partner.

like our study, none of these studies compares markets with equivalent non-market settings. Moreover, unlike in our study, trades do not imply negative correlation of risk, while the correlation structure of risk is crucial to predict how social comparison is expected to affect risk premia. The second strand of literature concerns the literature trying to understand what determines risk premia in financial decision making. Within this context particularly related are Campbell and Cochrane (1999), Wachter (2006) or Aldrich and Gallant (2011) who show that models involving habit formation can explain asset prices and short- and long-run equity premium puzzles.

2   Methods

In all treatments of our experiment, a group of five agents traded assets in two parallel but isolated markets during three repetitions of ten trading periods. At the beginning of each repetition all subjects were informed that each asset has a return of either 50, 100 or 150, but they did not know the probability distribution of returns. The probabilities associated with these three outcomes were 1/5, 3/5 and 1/5 for one asset and 2/5, 1/5 and 2/5 for the other asset. Hence, both assets had an equal expected value of 100, but differed in riskiness: one asset was more risky than the other in the sense of mean-preserving spreads. Each subject received one possible return value as a signal and they knew that the probability to receive a particular return value as signal was equal to the probability that the asset returns this value. Hence, even though the signal is far from perfect, it is informative. Signals were randomly allocated in such a manner that on aggregate perfect information on the return probabilities was available in the group. The asset markets and signal distributions were kept constant within each repetition, but varied across repetitions (Appendix A). In each trading period all agents started with one unit of each asset in stock. Next, they simultaneously and independently specified for each asset their selling price and buying price. The selling price indicates for which price they are willing to sell their unit; the buying price indicates for which price they are willing to buy a second unit.

In the treatments with market interaction (the market treatments) assets are traded via a call auction mechanism (Plott and Smith, 2008). Trade occurs when some subject's buying price is above another subject's selling price. The market price is the price at which all possible trades can take place simultaneously. In case no trade is possible (i.e. when the highest buying price is below the lowest selling price), no market price is determined; when there are multiple prices at which the market clears, the market price is the average of these. After each trading period, subjects are informed about the market price and, hence, their asset and cash holdings. They did not learn the return values of the assets.

In the treatments without market interaction (the non-market treatments), purchases and sales of stocks were determined according to a Becker-DeGroot-Marschak (BDM) mechanism (Becker et al., 1964). Instead of assets being bought or sold at the market price, subjects'

purchases and sales were determined by a randomly drawn price. Subjects with a selling price below the random price sell their unit and those with a buying price above this random price buy a second unit. To equalise the information flow with the market treatment, in addition to this random price, the fictitious market price – the price that would have been the equilibrium price based on the submitted bids and asks – was communicated after each trading period.

Both the market and the non-market treatments were run in two informational variations: one where after each trading period subjects were informed about others' buying and asking prices (with social comparison (SC) information), and one where they did not receive such information (without SC information). From the information about the prices at which assets were sold and bought, subjects could precisely infer the asset and cash holdings of each individual trading partner in the treatments with SC information.

The experiments were conducted in the BEElab, the experimental laboratory at Maastricht University, in November 2014 and June 2015.[2] We recruited undergraduate students from various disciplines via ORSEE (Greiner, 2015). All interactions took place anonymously via computer clients that where connected to a central server using z-Tree (Fischbacher, 2007). Before they entered the trading phase, subjects' understanding of the instructions was tested via a series of control questions. Instructions and screenshots are provided in Appendices B and C. At the end of all the experiment, subjects participated in a short questionnaire in which we elicited a few personal characteristics (see Appendix D). Subjects were paid according to one randomly chosen trading period and learn the factual returns of the two assets only for this payment-relevant trading period. In total, 160 students participated in the experiment: 8 groups of 5 per treatment (see Appendix E for information on our subject pool). A typical session lasted about 90 minutes and the average payoff was 15.26 Euros (including a 5.00 Euro show-up fee).

3 Results

We are interested in the extent of risk-taking across the four conditions. We measure the extent of risk-taking by the premium participants require to incur risks. A risk premium is usually defined as the return in excess of the risk-free rate an asset is expected to yield to compensate the investor for the risk s/he is taking. Since both assets in our setting yield the same expected return, we define the risk premium here as the difference in the (fictitious) market price between the less and the more risky asset. This risk premium measures how much the market values avoiding risk. If incentives created by market interactions were to

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[2]All experiments were conducted with the informed consent of healthy adult subjects who were free to withdraw from participation at any time. Only individuals who voluntarily entered the experiment recruiting database were invited, and informed consent was indicated by electronic acceptance of an invitation to attend an experimental session. The experiments were conducted following the peer-approved procedures established by Maastricht University's Behavioral and Experimental Economics Laboratory (BEElab). Our study was approved by the BEElab at a public ethics review and project proposal meeting that is mandatory for all scholars wishing to use the BEElab facilities.

encourage risk-seeking behaviour, we should observe a lower risk premium in the market treatment than in the non-market treatment.

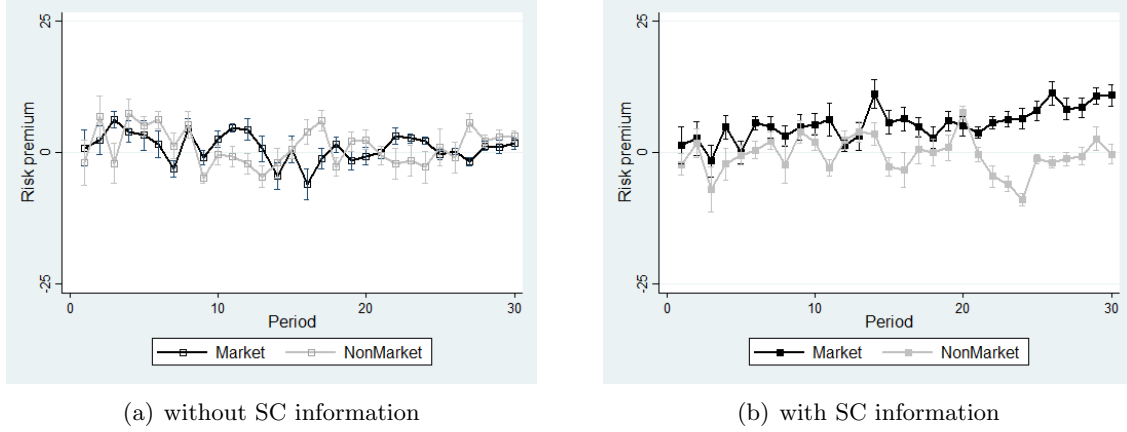(a) without SC information

(b) with SC information

Figure 1: Development of average risk premium in the different treatments.

Figure 1 shows the average risk premium over time in the treatment with (black) and without (grey) market interaction; the left panel shows the treatments without SC information and the right panel for those with SC information. For the treatments without SC information, the average risk premium hovers around zero for both the market and the non-market treatment. For the treatments with SC information, the average risk premium again is around zero for the non-market treatment but becomes larger over time for the market treatment, indicating that participants seem less willing to take risks in the market setting.[3]

In order to assess statistical significance of the treatment effects on risk premia, we ran a random-effects OLS regression estimating the following equation:

$$\text{RP}_j^t = \alpha + \beta_1 \times \text{Market} + \beta_2 \times \text{SCinfo} + \beta_3 \times \text{SCinfo} \times \text{Market} + \eta_j + \epsilon_j^t, \tag{1}$$

where RP_j^t refers to the risk premium of group j in period t, Market is a dummy for the market treatments and SCinfo a dummy for the presence of social comparison information. Table 1 presents the results. Of particular interest are the coefficients β_1 measuring the impact of market interactions in the absence of SC information and the coefficient $\beta_1 + \beta_3$ measuring the impact of market interactions with SC information.[4]

Market interaction decreases the willingness to take risks if and only if there is SC information. While β_1 is small, changing in sign and statistically not significant, the coefficient $\beta_1 + \beta_3$ is substantial and growing over time. Across the last 5 periods the risk premium in

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[3]In all four treatments, both assets are priced substantially below their expected value of 100 (see Table F.1 in Appendix F) indicating risk aversion in all treatments.

[4]The coefficients β_2 and $\beta_2 + \beta_3$ capture differences in the risk premium between social comparison information conditions for the non-market and market treatment. While these comparisons are clearly of interest as well, our experiment has not been designed with the purpose to decouple subjects' attitude towards risk-taking from their learning of the realisation probabilities. Disentangling these would require additional experimental treatments.

	(1)	(2)	(3)	(4)
	All	6–10	16–20	26–30
Constant (α)	1.042	1.974	1.995	2.034
	(2.094)	(3.960)	(4.166)	(3.590)
Market (β_1)	0.008	−0.801	−3.401	−1.642
	(3.121)	(4.494)	(6.327)	(3.516)
SCinfo (β_2)	−1.982	−0.465	−1.033	−3.480
	(1.617)	(6.894)	(5.289)	(4.241)
SCinfo × Market (β_3)	6.556**	4.198	7.714	13.09***
	(3.151)	(9.340)	(8.393)	(4.028)
$\beta_1 + \beta_3$	6.564*	3.379	4.313	11.448**
p-value test $\beta_1 + \beta_3 = 0$	0.073	0.590	0.548	0.044
$\beta_2 + \beta_3$	4.574	3.733	6.681	9.610*
p-value test $\beta_2 + \beta_3 = 0$	0.195	0.526	0.147	0.063
Observations	880	152	152	152
Number of groups	32	32	32	32

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 1: Difference in risk premium between treatments. Column (1) is based on data over all trading periods, Columns (2)–(4) focus on the second half of each of the three repetitions. The reason of the number of observations being smaller than 960 (32×30) or 160 (32×5) is that for some periods the risk premium could not be determined due to at least one of the assets not being traded.

"transparent markets" is more than 11 tokens higher, a more than 500% increase over the corresponding non-market setting (Column (4) in Table 1). Despite the fact that excessive risk-taking with all its consequences occurs frequently in markets, we find that markets are not causal to such behaviour. By contrast, markets even reduce risk-taking in the presence of social comparison information, suggesting that markets may not be the worst institution to discipline excessive risk-taking.

Further analysis and robustness checks did not reveal statistically significant time trends within treatments (Table F.4 in Appendix F) and reveal that the effect is stronger if the initial distribution of signals seems favourable to the less risky asset for a greater number of participants (Table F.2 in Appendix F and Figure G.1 in Appendix G). Controlling for participants' personality and demographic characteristics elicited in a post-experimental questionnaire does not affect the estimated coefficient size $\beta_1 + \beta_3$ substantially. Effect sizes tend to be even bigger and statistical significance improves once these controls are included (Table F.5 in Appendix F). Furthermore, risk premia are found to be higher if market participants are more risk averse or have higher cognitive ability and they are lower if participants are male, more optimistic, conscientious or neurotic according to measures elicited in the questionnaire (Table F.5 in Appendix F).

Why does market interaction decrease participants' willingness to take risks? The fact that markets decrease willingness to take risks if and only if social comparison information is

provided suggests that the latter plays an important role in explaining the effect of markets on risk-taking behaviour. Social comparison information will matter, for example, if people have social reference points, i.e. if they evaluate their outcomes relative to the outcomes of others. In fact, there is a solid body of evidence demonstrating loss aversion with respect to social reference points (Vendrik and Woltjer, 2007; Kuhn et al., 2011; Linde and Sonnemans, 2012). As we show formally in Appendix H, if participants have reference dependent preferences with respect to a social reference point, then our markets will induce higher risk premia whenever social comparison information is provided. The correlation structure of risk plays an important role for this effect. To see this, note that when a given asset is traded, risk is negatively correlated: if one trader's risk increases explicitly, then the others decreases implicitly. One implication of such negative correlation is that risk premia in the market condition are increasing in the extent to which social comparison utility matters to individuals.

While we find this explanation intuitively appealing and while it is able to explain all of our key results, some other possible mechanisms seem worth pointing out. First, reference-dependent preferences with probability weighting (Tversky and Kahneman, 1992) have been linked with a preference for positively skewed securities (Barberis and Huang, 2008). Such a mechanism, however, cannot explain any of our treatment differences, because it should operate in the same way in the market and non-market condition and with and without social comparison information. Second, while in the BDM the distribution of prices is uniform, in the market this is typically not the case. This differences in the distributions of prices could lead traders to be perceived as more risk averse in the market setting under non-expected utility theory (Machina, 1982). However, we study risk premia comparing high and low risk assets and it is not clear why they should be affected by this difference. Moreover, we find that markets lead to increased risk aversion if and only if social comparison information is provided; distributional differences alone cannot account for this effect. Last, one could imagine that participants are more likely to imitate others when social comparison information is provided. Imitation learning can, however, not explain why participants should take fewer risks in the market than non-market setting.

4 Conclusions

We investigated whether markets induce risk taking behaviour. In a lab experiment we isolate the effects of market interaction keeping other possibly confounding factors constant. Somewhat surprisingly, we found that markets decrease participants' willingness to take risks. This is the case, however, if and only if information about the outcomes of other market participants is provided. These findings can be explained by social comparison utility in the presence of negatively correlated risks.

It is important to note that our results do not question the fact that frequently we do observe excessive risk-taking in markets. There is ample evidence demonstrating that this

can indeed be the case. What they do question, however, is whether market interaction is causal to such risk taking. Our results suggest that it is other factors, such as specific aspects of remuneration packages, bonuses paid to financial traders, self-selection into trading, or individual factors (see e.g. Kuhnen and Knutson (2005); Porcelli and Delgado (2009); Coates et al. (2009); Holmen et al. (2014); Kleinlercher et al. (2014); Eckel and Füllbrunn (2015)) that cause excessive risk taking in financial markets.

Our results suggest some possibilities to harness social comparison effects to discourage excessive risk taking. In some online platforms (zulutrade.com; etoro.com), for example, individual investors can observe outcomes of other market participants and can even decide to mimic their strategies. In other markets, by contrast, there is only limited transparency and if at all outcomes of only few market participants can be observed. Since, adding social comparison information increases risk premia, this could be one channel why less risky behaviour is observed in exchanges compared to OTC or such dark pool markets. Our results hence contribute to the debate around recent legislation (Dodd-Frank Act in the U.S. and the "Markets in Financial Instruments Directive (MiFID II)" in the EU) that aims at providing transparency to dark pools, or even disallowing them altogether. Future research should study how robust our findings are across various dimensions (number and correlation structure of assets, the shape of information flows, how traders are remunerated) and if there are interaction effects when different institutional details are considered. One particularly interesting aspect to study, highlighted by recent financial crises, might be the case with positively correlated risk (Gortner and van der Weele, 2019).

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Appendix "Do markets encourage risk-seeking behaviour"

F.Mengel and R. Peeters

Contents

A Design Details and Procedures

Parameter settings   Table A.1 presents the parameter settings for the different matching groups in the different repetitions. In all matching groups the left (right) asset was referred to as the red (green) asset in the first repetition, as the yellow (purple) asset in the second repetition and as the blue (orange) asset in the third repetition. Across matching groups and repetitions there was variation in whether the left or the right asset was the more or less risky one. Moreover, the distribution of signals differed across matching groups and repetitions. We adopted two different distributions of signals: In distribution ρ_1 (ρ_2) three individuals receive a signal that the more (less) risky asset is marginally better, one that the less (more) risky asset is marginally better, and one that the less (more) risky asset is way better.

For instance, in matching group 3 and repetition 2 the left (yellow) asset was less risky than the right (purple) asset and the signal distribution was in accordance to distribution ρ_1 with individuals 1, 2 and 4 receiving a signal that the more risky asset is marginally better, individual 3 that the less risky asset is marginally better, and individual 5 that the less risky asset is way better.

Matching group	1–2			3–4			5–6			7–8		
Repetition	1	2	3	1	2	3	1	2	3	1	2	3
Color asset L Color asset R	red green	yellow purple	blue orange	red green	yellow purple	blue orange	red green	yellow purple	blue orange	red green	yellow purple	blue orange
Return L [1]	50	50	50	50	50	50	50	50	50	50	50	50
Return L [2]	100	50	50	50	100	100	100	50	100	50	100	50
Return L [3]	100	100	100	100	100	100	100	100	100	100	100	100
Return L [4]	100	150	150	150	100	100	100	150	100	150	100	150
Return L [5]	150	150	150	150	150	150	150	150	150	150	150	150
Return R [1]	50	50	50	50	50	50	50	50	50	50	50	50
Return R [2]	50	100	100	100	50	50	50	100	50	100	50	100
Return R [3]	100	100	100	100	100	100	100	100	100	100	100	100
Return R [4]	150	100	100	100	150	150	150	100	150	100	150	100
Return R [5]	150	150	150	150	150	150	150	150	150	150	150	150
Signal L [1]	100	150	50	100	100	100	100	50	50	150	100	150
Signal L [2]	50	150	150	50	50	100	50	150	100	100	150	50
Signal L [3]	100	50	100	150	100	50	150	50	100	150	100	150
Signal L [4]	100	50	50	50	100	150	100	150	150	50	100	100
Signal L [5]	150	100	150	150	150	100	100	100	100	50	50	50
Signal R [1]	150	50	150	50	150	50	50	100	150	50	150	100
Signal R [2]	100	100	100	100	100	50	150	100	150	150	100	150
Signal R [3]	50	100	50	100	50	150	100	150	50	100	50	100
Signal R [4]	150	100	100	150	150	100	150	100	100	100	50	50
Signal R [5]	50	150	100	100	50	150	50	50	50	100	150	100
Distribution	ρ_1	ρ_2	ρ_1	ρ_1	ρ_1	ρ_2	ρ_2	ρ_1	ρ_2	ρ_2	ρ_2	ρ_1

Table A.1: Parameter settings.

Strategic manipulation   There is not much evidence of strategic manipulation in experimental double auction markets even in settings that were designed to encourage such manipulation (Veiga and Vorsatz, 2009). Our setting is less conducive to strategic manipulation, because there are no informational asymmetries. Hence, none of the participants should feel that they have an informational advantage they could potentially capitalize on. Finally, even if some participants did try to attempt to manipulate prices, it is not clear how this should

differentially affect the more and less risky assets and hence the risk premium.

Sources of financial support   The payments to the participants in the experiments were covered by the private research budget provided by the departments of the authors. Both authors were partly supported by personal research grants from the Dutch Science Foundation (NWO Veni and Vidi grants).

Ethical approval   The experiments were conducted at the BEElab, the experimental laboratory of the School of Business and Economics of Maastricht University (where both authors were affiliated at the time the experiment was conducted). Experiments can only be conducted at the BEElab after the design and procedures have been presented at a "proposal meeting" and subsequently have found approval of the lab-manager and the other lab-members present at the meeting. This internal approval process, that screens in accordance to the ruling international standards of economic experiments, replaces an official IRB approval (which is to date rather uncommon in the Netherlands).

B   Sample Instructions (Market–SCinfo)

Welcome and thanks for participating in this experiment. Please, read these instructions carefully. They are identical for all the participants with whom you will interact during this experiment. If you have a question, please, raise your hand. One of the experimenters will come to you and answer your questions. From now on communication with other participants is not allowed. If you do not conform to these rules we are sorry to have to exclude you from the experiment. Please do also switch off your mobile phone at this moment.

At the end of the experiment you will receive a payment. How much you get depends on your decisions and those of other participants. During the experiment the earnings are expressed in ECU (Experimental Currency Units). At the end of the experiment the ECUs collected are converted into Euros according to the exchange rate 1 ECU = 5 Eurocents. In addition there is the 5 Euro show up fee. All your decisions will be treated confidentially.

The experiment

There will be two different **assets** in this experiment, which will be labeled with different colors. In these instructions we will talk about the BLACK asset and the WHITE asset. In the experiment, however, different colors will be used.

Both assets have one of the following three possible **returns**: 50 ECU, 100 ECU or 150 ECU. The difference between the two assets is the probabilities with which these possible returns realize. In other words the chance to get 50 or 100 or 150 is different for the BLACK compared to the WHITE asset. The only thing you know is that each of these returns is possible with positive probability for both assets.

One way to think about this is that both the BLACK and the WHITE asset represent an envelope with money containing bills of 50 ECU, 100 ECU and 150 ECU. The difference is that the BLACK and WHITE envelope might contain different numbers of each of these bills. The only thing you know is that in each envelope there is at least one bill of each kind.

In total the experiment consists of three **repetitions**. In each repetition there will be different assets. You can trade assets in each repetition for ten **trading periods**.

Signal

At the beginning of each repetition you receive a **signal**. A signal is a piece of information for you about each of the assets. You will receive the following signal. For each asset we will tell you one number 50, 100 or 150. The probability with which we tell you each of these numbers corresponds to the probability with which the asset has this return. Hence the higher the probability that the asset has a certain return, the higher the chance that we show you this number.

In terms of our envelope example you can think about your signal as follows. We randomly draw one bill out of each envelope and show it to you. Hence the more bills of a certain type

an envelope contains, the more likely it is that we draw one of these.

In the experiment you will be matched with four other participants in a **group**. Not only you, but also all of the other group members will receive a signal in the same manner as you. Note, however, that different participants might receive different signals.

The trading

In each trading period, you have one share of each asset (BLACK and WHITE) in stock. You will tell us two numbers:

(i) your **buying price**: this is the maximum price at which you are willing to buy one more share of this asset, and

(ii) your **selling price**: this is the minimum price at which you are willing to sell your share of this asset.

Hence, in total you will tell us four numbers, two for each asset.

All group members will tell us their four numbers simultaneously. Afterwards, for each asset BLACK and WHITE, the buying prices of all group members are ranked highest to lowest and the selling prices of all group members are ranked lowest to highest.

The **market price** of each asset is determined as follows:

1. First we compare the lowest selling price with the highest buying price.

   - If this selling price is higher than this buying price, then there is no market price (which we will mark with xxx).

   - Otherwise, we proceed to 2.

2. Compare the second-lowest selling price with the second-highest buying price.

   - If this selling price is higher than this buying price, then the market price is the average of the lowest selling price and the highest buying price.

   - Otherwise, we proceed with 3.

3. Compare the third-lowest selling price with the third-highest buying price.

   - If this selling price is higher than this buying price, then the market price is the average of the second-lowest selling price and the second-highest buying price.

   - Otherwise, we proceed to 4.

4. Compare the fourth-lowest selling price with the fourth-highest buying price.

   - If this selling price is higher than this buying price, then the market price is the average of the third-lowest selling price and the third-highest buying price.

5

- Otherwise, we proceed to 5.

5. Compare the fifth-lowest (or highest) selling price with the fifth-highest (or lowest) buying price.

  - If this selling price is higher than this buying price, then the market price is the average of the fourth-lowest selling price and the fourth-highest buying price.

  - Otherwise, the market price is the average of this fifth-lowest selling price and this fifth-highest buying price.

For example, assume that, for some asset, the five buying prices are (5400, 100, 21, 7, 1) and the selling prices are (8, 24, 65, 201, 300). The lowest selling price of 8 is lower than the highest buying price of 5400. Hence, we proceed to step 2. The second-lowest selling price of 24 is lower than the second-highest buying price of 100. Hence, we proceed to step 3. The third-lowest selling price of 65 is higher than the third-highest buying price of 21. Hence, two shares are traded in your group and the market price is the average between the second-lowest selling price of 24 and the second-highest buying price of 100, which is 62.

Once the market price is determined, all group members with buying prices above the market price and with selling prices below the market price will trade one share of the asset (at the market price). In case there is excess demand or excess supply, group members with higher buying prices and lower selling prices will trade first. In case of ties (equal buying prices or equal selling prices) between group members, a random selection of these will be trading.

Information

At the end of each period you will observe for each asset (BLACK and WHITE):

- the market price;

- the buying and selling prices of all group members;

- whether you sold the asset, you bought the asset, or did not make any trade at all.

Your earnings in the experiment

At the end of the experiment one period is randomly drawn. Your earnings in the experiment are based on your payoff from that randomly drawn period.

First the return of the BLACK and the WHITE asset (either 50, 100 or 150) are determined according to the respective probabilities. In terms of our envelope example you can think of one bill being randomly drawn from the BLACK and one from the WHITE envelope.

Your payoff in this period is then computed as follows:

$$
\begin{aligned}
\text{Payoff} \quad = \quad & \text{Number of shares of BLACK asset} \times \text{Return of BLACK asset} \\
& + \text{ Number of shares of WHITE asset} \times \text{Return of WHITE asset} \\
& - \text{ Market price BLACK asset } \textit{if} \text{ a share of this asset is bought} \\
& + \text{ Market price BLACK asset } \textit{if} \text{ a share of this asset is sold} \\
& - \text{ Market price WHITE asset } \textit{if} \text{ a share of this asset is bought} \\
& + \text{ Market price WHITE asset } \textit{if} \text{ a share of this asset is sold}
\end{aligned}
$$

Questionnaire

At the end of the experiment there will be a short questionnaire for you to fill in.

If you have any questions about these instructions or the experiment, then please raise your hand now and someone will come and answer them. Once everyone has finished reading the instructions some control questions will appear on your screen that will allow you to test your understanding of the instructions.

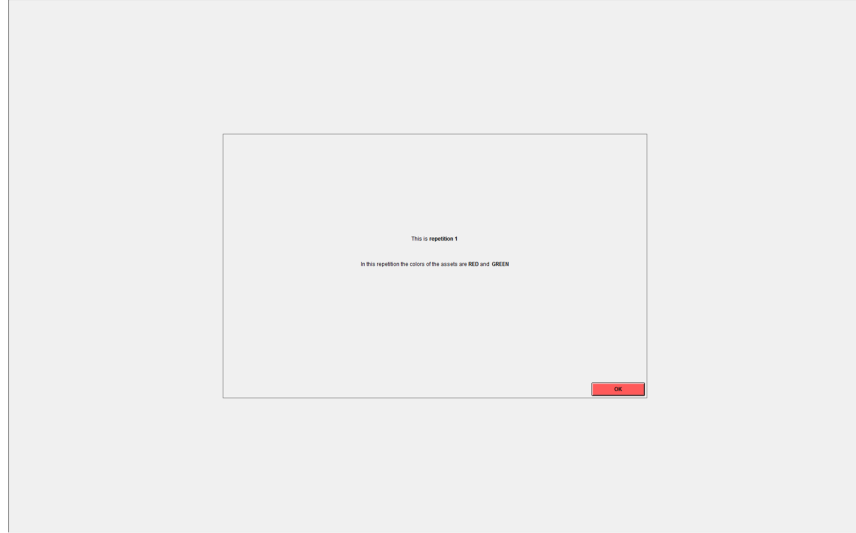# C   Screenshots (Market–SCinfo)

Figure C.1: Start of a new repetition. Before each sequence of ten trading periods, participants get notified via this screen that a new repetition of ten trading periods starts. Across repetitions, color-names of assets, the realization probabilities of the possible return values, and the signals are different (see Table A.1); within repetitions these are constant.
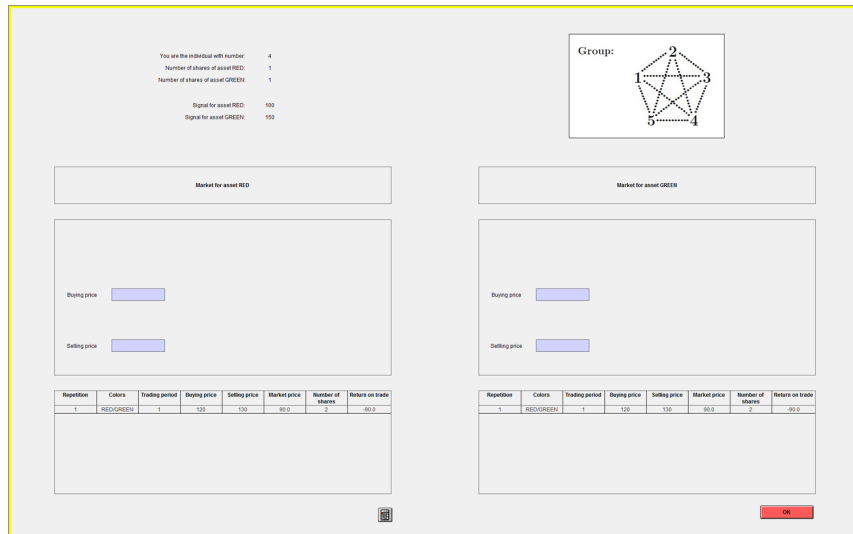

Figure C.2: Decision screen. At the upper-left part of the screen, individuals are notified on their identity within the group (where the figure at the upper-right shows the group; dashed line are not present in the treatments without SC information), the number of shares of each asset in stock (which equals 1 at the beginning of each trading period), and the signals they obtained for each asset. In the middle part, participants enter their buying and selling prices for each of the assets; values between 50 and 150 needs to be entered, with buying prices not being above the selling prices. At the bottom of the screen there are history boxes storing important feedback on what happened before in the markets for the right and left asset.
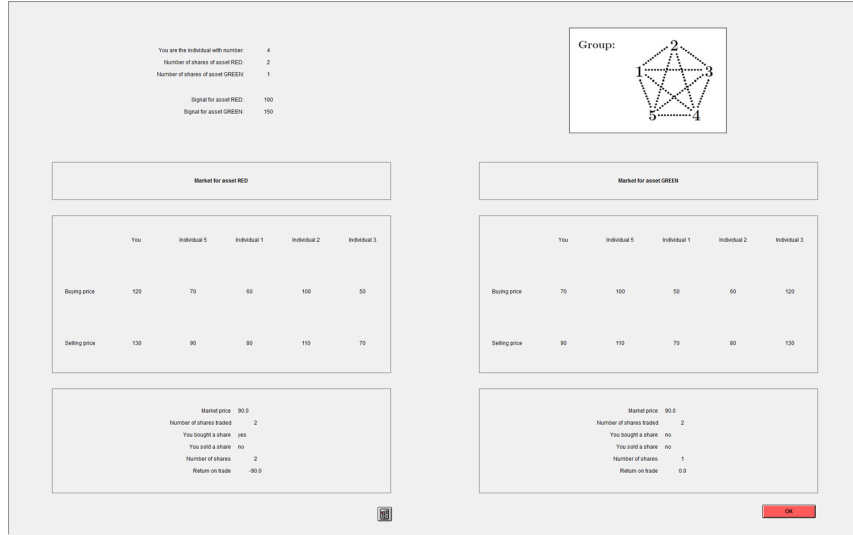
Figure C.3: Feedback screen. The upper part of the screen is organized similar as in the decision screen. The middle part contains information on all individuals their buying and asking prices (in the treatment without SC information only information on own buying and selling prices are contained). The bottom part reports important feedback on the consequences of the decisions in the markets for the right and left asset, such as: the market price, the number of shares traded, whether you bought another share or sold the one you had in stock, the number of shares left after trade, and the return on trade (which is negative in case an asset is bought and positive in case an asset is sold). In the nonmarket treatments, the market price is labeled "group value" and in addition the randomly drawn price at which exchange takes place is presented. The returns of the assets are not learnt until the very end of the session.
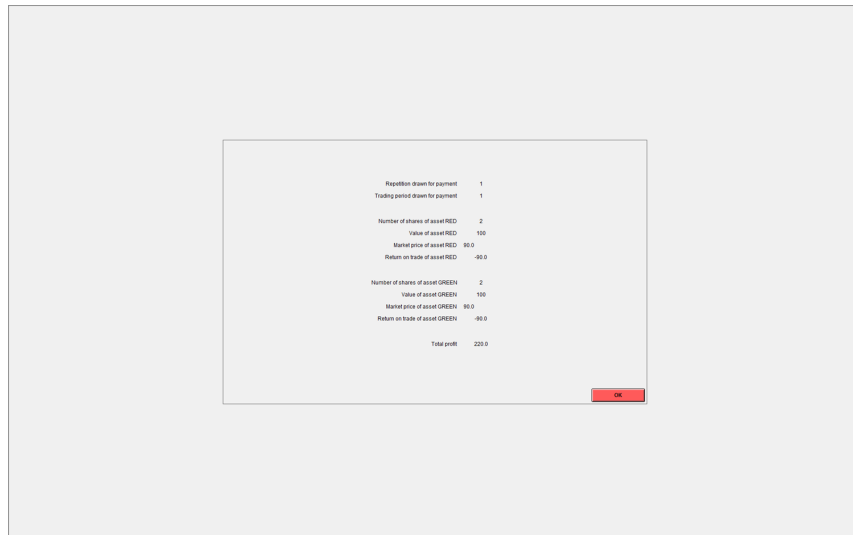

Figure C.4: Screen with final payment information. Participants are informed which repetition and trading period are selected for final payment. For each of the assets, participants see how many shares they had after trade and what they paid for buying another share or selling their share (or 0 if neither of the two happened) in that respective repetition and trading period. Finally, the participants learn the value (return) of the assets. All this information aggregates into a final payoff, that is presented (in ECU and excluding show-up fee) on the last line.

D Post-experimental Questionnaire

Cognitive ability For the cognition task, we used the symbol-digit correspondence test from the Wechsler Adult Intelligence Scale (WAIS), in which subjects had 90 seconds to find as many correspondences between symbols and numbers as they could, using the correct number for each symbol (see Figure D.1). Speed and accuracy under time pressure determine an individuals ability (Dohmen et al., 2010).
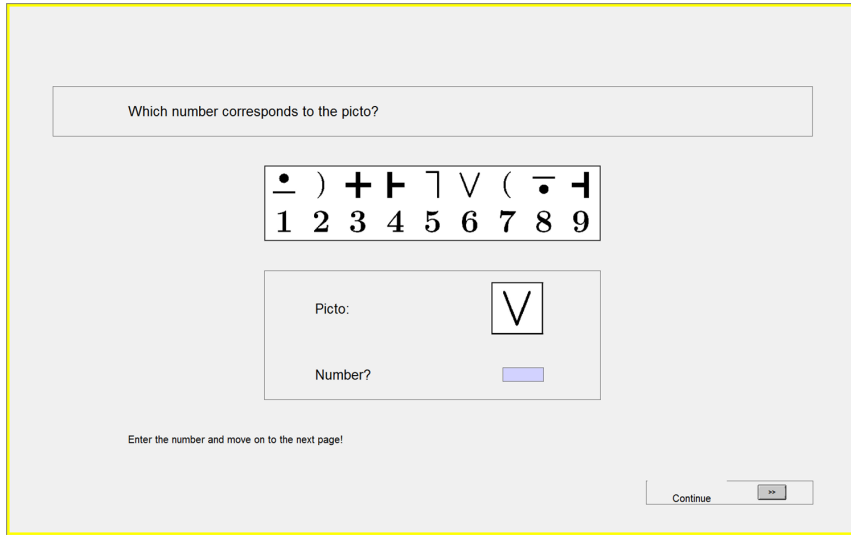

Figure D.1: Screenshot of cognitive ability test.

Demographics Participants answered the following questions:

1. What is your age?

2. What is your gender?

3. What is your origin?

4. What are you studying?

5. For how many years in total have you been studying at this or another university?

Risk attitude We elicited risk attitude using the direct approach as suggested in Dohmen et al. (2011). Participants answered the question

> How do you see yourself: Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?

on a ten-point scale running from "Not at all willing to take risks" to "Very willing to take risks".

Machiavellianism   The Machiavellianism score was elicited using the Mach-IV test (Christie and Geis, 1970). Participants indicate on a five-point Likert scale (running from "strongly disagree" to "strongly agree") the degree to which they personally agree or disagree with each of the following statements:

1. Never tell anyone the real reason you did something unless it is useful to do so.

2. The best way to handle people is to tell them what they want to hear.

3. One should take action only when sure it is morally right.

4. Most people are basically good and kind.

5. It is safest to assume that all people have a vicious streak and it will come out when they are given a chance.

6. Honesty is the best policy in all cases.

7. There is no excuse for lying to someone else.

8. Generally speaking, people won't work hard unless they're forced to do so.

9. All in all, it is better to be humble and honest than to be important and dishonest.

10. When you ask someone to do something for you, it is best to give the real reasons for wanting it rather than giving reasons which carry more weight.

11. Most people who get ahead in the world lead clean, moral lives.

12. Anyone who completely trusts anyone else is asking for trouble.

13. The biggest difference between most criminals and other people is that the criminals are stupid enough to get caught.

14. Most people are brave.

15. It is wise to flatter important people.

16. It is possible to be good in all respects.

17. P.T. Barnum was wrong when he said that there's a sucker born every minute.

18. It is hard to get ahead without cutting corners here and there.

19. People suffering from incurable diseases should have the choice of being put painlessly to death.

20. Most people forget more easily the death of their parents than the loss of their property.

Items 3, 4, 6, 7, 8, 9, 10, 11, 13, 14, 16 and 17 are reverse coded.

Competitiveness   To assess the participants' desire to win in interpersonal situations, we asked them to indicate on a five-point Likert scale (running from "strongly disagree" to "strongly agree") their belief about themselves concerning the following items:

1. I get satisfaction from competing with others.

2. I am a competitive individual.

3. I will do almost anything to avoid an argument.

4. I try to avoid competing with others.

5. I often remain quiet rather than risk hurting another person.

6. I find competitive situations unpleasant.

7. I try to avoid arguments.

8. In general, I will go along with the group rather than create conflict.

9. I don't like competing against other people.

10. I dread competing against other people.

11. I enjoy competing against an opponent.

12. I often try to out perform others.

13. I like competition.

14. I don't enjoy challenging others even when I think they are wrong.

Responses to these 14 items aggregate in the Revised Competitiveness Index (Houston et al., 2002). Items 1, 2, 4, 6, 9, 10, 11, 12 and 13 capture the "Enjoyment of Competition"; items 3, 5, 7, 8 and 14 capture "Contentiousness". Items 3–10 and 14 are postulated in reverse.

Optimism To assess participants' degree of optimism we use the Life Orientation Test–Revised (LOT-R) as developed by Scheier et al. (1994). Participants indicated on a five-point Likert scale (running from "strongly disagree" to "strongly agree") their belief about themselves concerning the following items:

1. In uncertain times, I usually expect the best.

2. It's easy for me to relax.

3. If something can go wrong for me, it will.

4. I'm always optimistic about my future.

5. I enjoy my friends a lot.

6. It's important for me to keep busy.

7. I hardly ever expect things to go my way.

8. I don't get upset too easily.

9. I rarely count on good things happening to me.

10. Overall, I expect more good things to happen to me than bad.

Items 3, 7 and 9 are reverse coded; items 2, 5, 6 and 8 are fillers.

Big Five   The Big Five covers five broad dimensions of personality: openness, conscientiousness, extraversion, agreeableness, and neuroticism (Costa and McCrae, 1992). Participants indicated on a five-point Likert scale (running from "strongly disagree" to "strongly agree") their belief about themselves concerning the following fifteen items as they are used in the German Socio-Economic Panel:

1. I am someone who does a thorough job.
2. I am someone who is communicative, talkative.
3. I am someone who is somewhat rude to others.
4. I am someone who is original and comes up with new ideas.
5. I am someone who worries a lot.
6. I am someone who has a forgiving nature.
7. I am someone who tends to be lazy.
8. I am someone who is outgoing, sociable.
9. I am someone who values artistic experiences.
10. I am someone who gets nervous easily.
11. I am someone who does the things effectively and efficiently.
12. I am someone who is reserved.
13. I am someone who is considerate and kind to others.
14. I am someone who has an active imagination.
15. I am someone who is relaxed, handles stress well.

Items 4, 9 and 14 relate to the factor openness; items 1, 7 and 11 to conscientiousness; items 2, 8 and 12 to extraversion; items 3, 6 and 13 to agreeableness; and items 5, 10 and 15 to neuroticism. Items 3, 7, 12 and 15 are stated in reversed form.

E   Sample Information

In this section we provide some information about our sample. The experiments were conducted at the BEElab at Maastricht University, where the subject pool consists mostly (but not uniquely) of undergraduate students in areas such as law, business, arts and culture and liberal arts degrees. Most students are from either Germany or the Netherlands, but there are also substantial shares of other European countries, as well as a number of Asian, South- and North-American students (see Figure E.1).

	Market	Market–SCinfo	NonMarket	NonMarket–SCinfo*
Gender (1=male)	0.425	0.550	0.375	0.400
	[0,1]	[0,1]	[0,1]	[0,1]
Age	20.525	20.9	20.825	21.700
	[18,24]	[18,25]	[18,25]	[18,27]
Risk aversion	3.925	3.725	4.575	4.000
	[2,9]	[1,7]	[0,9]	[0,7]
Cognitive ability	43.9	39.02	38.55	41.2
	[28,57]	[23,52]	[25,48]	[31,53]
Machiavellianism	60.825	59	58.975	58.15
	[48,74]	[47,76]	[46,75]	[38,76]
Competitiveness	45.550	46.650	47.375	46.500
	[26,68]	[29,70]	[20,70]	[28,64]
Optimism	19.90	19.375	20.075	19.65
	[11,28]	[9,25]	[11,30]	[10,28]
Openness (B5)	10.550	10.825	10.775	10.600
	[3,15]	[6,15]	[6,15]	[6,13]
Conscientiousness (B5)	9.875	10.025	10.675	10.800
	[5,14]	[5,15]	[5,15]	[5,15]
Extraversion (B5)	10.850	10.725	11.025	11.150
	[5,15]	[6,15]	[5,15]	[5,14]
Agreeableness (B5)	10.95	11.025	11.15	11.85
	[6,14]	[6,14]	[6,15]	[8,15]
Neuroticism (B5)	8.8	9.175	8.7	9
	[3,15]	[4,15]	[3,15]	[5,15]

*Half of the questionnaire data in this treatment were lost due to a server crash.

Table E.1: Mean and range for a number of variables.

Table E.1 summarizes some statistics (mean and range) of our sample. The information on sample characteristics was collected in a post experimental questionnaire, and unfortunately for the treatment NonMarket–SCinfo, questionnaire data were lost for half of the participants due to a server crash. With this caveat, our sample appears gender balanced across all treatments with the share of men ranging between 37–55%. On average participants are about 21 years old, but age ranges between 18 and 27. The table also reports a number of measures on risk aversion, cognitive ability, machiavellianism, competitiveness and optimism as well as the Big5 personality traits elicited as described in detail in Appendix D.

Figure E.2 illustrates the cdfs for age, risk aversion and cognitive ability, Machiavellianism, competitiveness and optimism. The figure illustrates that, despite some differences in means, the overall distributions do not substantially differ; only on cognitive ability participants in the Market treatment seem to score somewhat higher, though there are no differences between our key treatments Market–SCinfo and Nonmarket–SCinfo ($p = 0.2135$, two-sided ranksum test based on $n = 60$ observations). Figure E.3 illustrates the cdfs for the Big5 personality traits. Again, there are no notable differences across treatments. Table F.5 in Appendix F includes all controls in our main regression (Equation (1)) and shows that coefficient sizes $\beta_1 + \beta_3$ and $\beta_2 + \beta_3$ as well as statistical significance tend to increase after including all 11 variables from the questionnaire as controls.

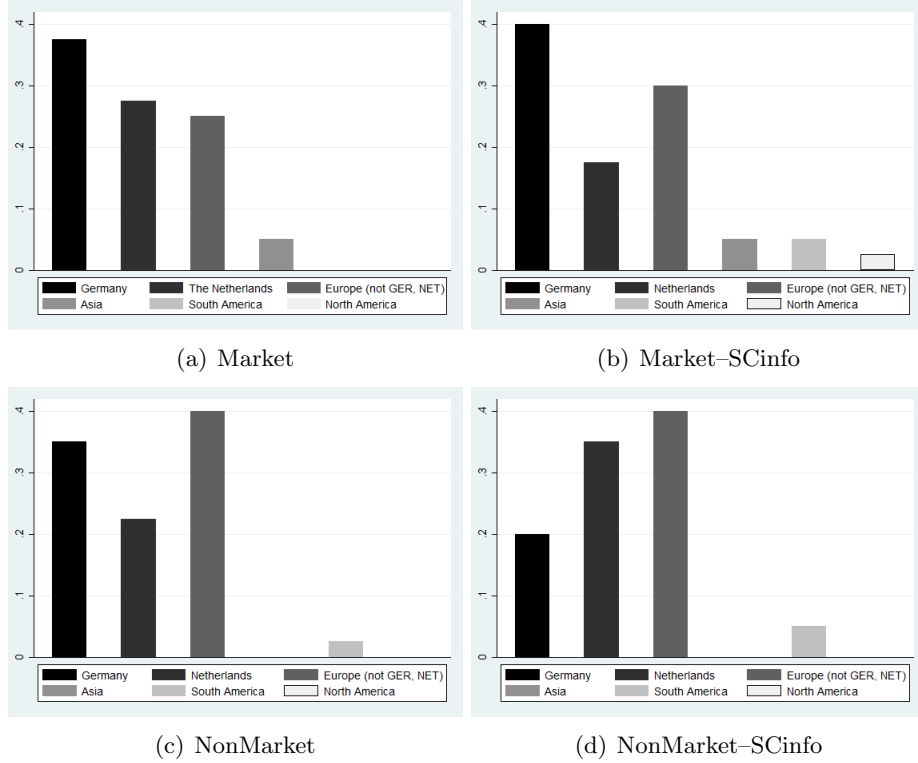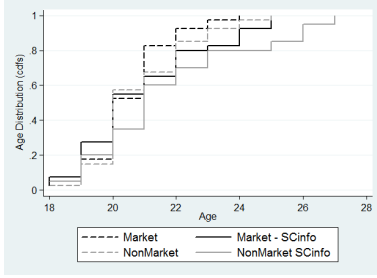(a) Market

(b) Market–SCinfo

(c) NonMarket

(d) NonMarket–SCinfo

Figure E.1: Country or region of participants' nationalities.
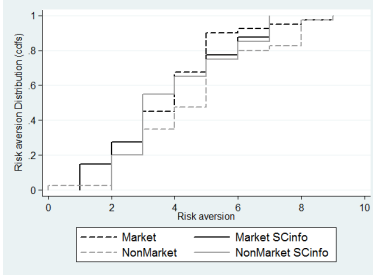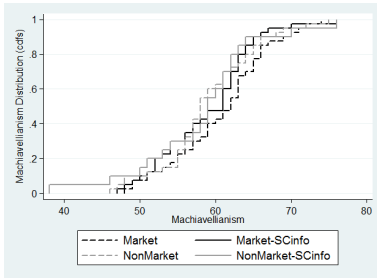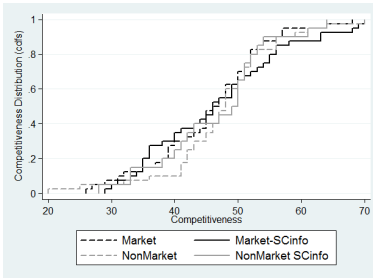
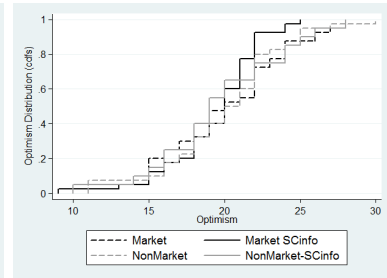(a) Age   (b) Risk aversion measure   (c) Cognitive ability
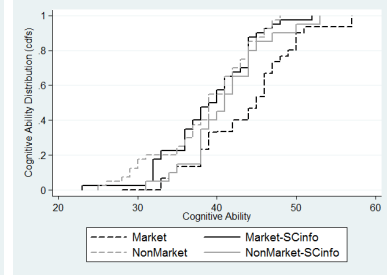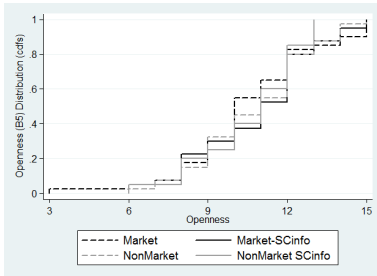
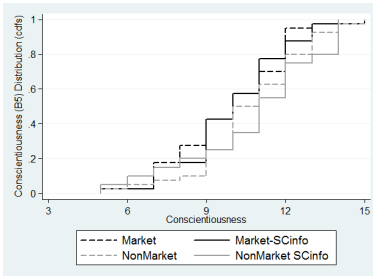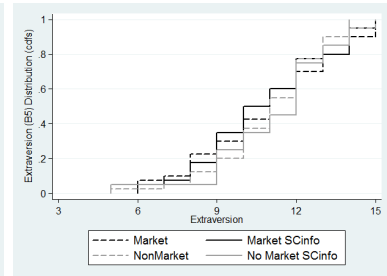(d) Machiavellianism   (e) Competitiveness   (f) Optimism

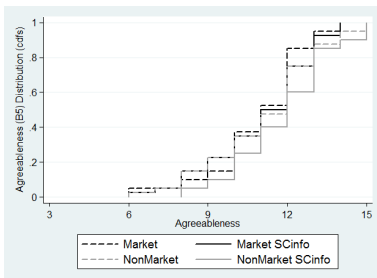Figure E.2: A number of sample characteristics (cdfs).
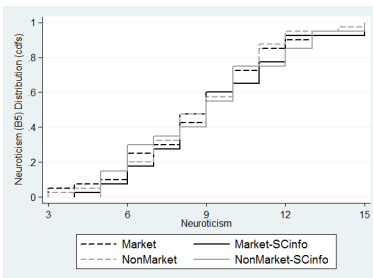

(a) Openness (B5)   (b) Conscientiousness (B5)   (c) Extraversion (B5)

(d) Agreeableness (B5)   (e) Neuroticism (B5)

Figure E.3: A number of sample characteristics (cdfs).

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F   Additional Tables

Table F.1 shows descriptive statistics (mean and range across all 30 periods) for a number of different variables. It can be seen that the risk premium is highest in the market treatment with SC information and that this is due to both a higher ask and a higher bid premium (defined as the difference between asks and bids, respectively, between the less risky and more risky asset). Prices tend to be somewhat lower in the market treatments, mostly due to lower asks, but the differences are relatively small. The volume of trade is highest in the market treatment without SC information and decreases both as SC information is added or market interaction is taken away. In all treatments and groups there was at least one trade in each round, though not always both assets were traded.

	Market	Market–SCinfo	NonMarket	NonMarket–SCinfo
Bid low risk asset	62.98	70.14	68.31	70.27
	$[50, 150]$	$[50, 150]$	$[50, 150]$	$[50, 150]$
Ask low risk asset	79.96	92.78	93.70	97.61
	$[50, 150]$	$[50, 150]$	$[50, 150]$	$[50, 150]$
Price low risk asset	67.06	76.90	77.71	80.90
	$[50, 125]$	$[50, 110]$	$[52.5, 122.5]$	$[57.5, 122]$
Bid high risk asset	63.16	66.26	69.05	70.00
	$[50, 150]$	$[50, 149]$	$[50, 150]$	$[50, 150]$
Ask high risk asset	81.14	89.52	92.80	100.13
	$[50, 150]$	$[50, 150]$	$[50, 150]$	$[50, 150]$
Price high risk asset	66.14	71.99	76.71	81.58
	$[50, 105]$	$[50, 109]$	$[50, 125]$	$[53, 122]$
Bid premium	0.17	3.88	-0.73	0.27
	$[-100, 100]$	$[-75, 100]$	$[-100, 100]$	$[-95, 99]$
Ask premium	-1.18	3.26	0.90	-2.51
	$[-100, 100]$	$[100, 100]$	$[-100, 100]$	$[-97, 100]$
Risk premium	1.08	5.59	1.16	-0.48
	$[-33.5, 35]$	$[-27.5, 45]$	$[-42.5, 42.5]$	$[-37.5, 33]$
Quantity traded low risk asset	1.70	1.58	1.36	1.17
	$[0, 3]$	$[0, 4]$	$[0, 3]$	$[0, 2]$
Quantity traded high risk asset	1.90	1.60	1.53	1.23
	$[0, 4]$	$[0, 3]$	$[0, 3]$	$[0, 2]$
Total number of trades	868	766	697	577

Table F.1: Mean and range for a number of variables.

Table F.2 shows the results of running regression (1) separately for the two signal distributions ρ_1 and ρ_2 (see Table A.1). It can be seen that the effects uncovered above are driven mainly by signal distribution ρ_2, though the direction of the effects is the same under ρ_1 (see also Figure G.1). This suggests that information matters for the size of the effect, though the direction is the same under both distributions.

Table F.3 shows a regression, where instead of risk premia we regress price on our market

	(1)	(2)	(3)	(4)
	All	26–30	All	26–30
Constant (α)	1.140	2.700	−0.196	1.294
	(4.472)	(5.652)	(3.087)	(5.424)
Market (β_1)	0.231	−2.900	2.915	−0.321
	(5.123)	(6.047)	(5.068)	(4.623)
SCinfo (β_2)	−2.601	−2.630	0.738	−4.371
	(3.908)	(4.316)	(2.822)	(8.251)
SCinfo × Market (β_3)	3.802	10.13*	6.030	16.10***
	(4.523)	(6.133)	(5.796)	(5.829)
$\beta_1 + \beta_3$	4.033	7.230	8.945***	15.779***
p-value test $\beta_1 + \beta_3 = 0$	0.457	0.537	0.005	< 0.001
$\beta_2 + \beta_3$	1.201	7.500	6.768	11.729
p-value test $\beta_2 + \beta_3 = 0$	0.770	0.325	0.152	0.148
Observations	440	76	440	76
Number of groups	32	16	32	16
Signal	ρ_1	ρ_1	ρ_2	ρ_2

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table F.2: Risk premium regressed on market and SC information dummies separately for ρ_1 and ρ_2.

and SC information dummies. The table shows that prices for the high risk asset in the market treatment with SC information are lower than those in the corresponding nonmarket treatment ($\beta_1 + \beta_3 < 0$) and that SC information increases prices for the low risk asset in the market setting, but not the nonmarket setting ($\beta_2 + \beta_3 > 0$; $\beta_2 = 0$). It also shows that in the absence of SC information market prices for all assets are lower under the market condition compared to the nonmarket condition.

Table F.4 shows the evolution of the risk premium over time in the different treatments. Even columns simply regress risk premium on period (1–30). Odd columns regress risk premium on "Trading period" (1–10), "Repetition" (1–3) as well as their interaction. The table shows that while risk premia tend to increase over time in Market–SCinfo, they tend to decrease in all other treatments, even though none of these trends appears statistically significant.

Table F.5 repeats the regression from Equation (1), but includes in even columns all 11 variables elicited in the post experimental questionnaire described in Appendix D (descriptive statistics on these variables can be found in Appendix E). A number of characteristics affect the risk premium: risk aversion and cognitive ability of market participants tend to increase risk premia, while optimism, conscientiousness and neuroticism tend to decrease the risk premium. The risk premium is also lower if there are more male participants in a market. Importantly, our coefficients of interest ($\beta_1 + \beta_3$ and $\beta_2 + \beta_3$) do not change much when questionnaire variables are included. If at all, effect sizes tend to increase upon including

	Low risk asset		High risk asset	
	(1)	(2)	(3)	(4)
	All	26–30	All	26–30
Constant (α)	77.65***	76.42***	76.63***	74.38***
	(2.843)	(3.216)	(2.672)	(4.576)
Market (β_1)	-10.32***	-12.91***	-10.51***	-11.22
	(3.813)	(4.853)	(3.352)	(7.024)
SCinfo (β_2)	3.585	3.125	5.269	7.046
	(4.181)	(5.671)	(4.544)	(9.189)
SCinfo $\times$ Market (β_3)	6.087	9.388	0.769	-4.183
	(6.239)	(10.94)	(5.167)	(10.86)
$\beta_1 + \beta_3$	-4.322	-3.522	-9.741***	-15.403**
p-value test $\beta_1 + \beta_3 = 0$	0.167	0.620	0.007	0.041
$\beta_2 + \beta_3$	9.672**	12.513*	6.038	2.863
p-value test $\beta_2 + \beta_3 = 0$	0.045	0.091	0.108	0.601
Observations	911	159	929	153
Number of groups	32	32	32	32

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table F.3: Market prices for the two assets.

	Market		Market–SCinfo		NonMarket		NonMarket–SCinfo	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	4.401	2.331	-0.202	1.492	-0.626	-0.111	4.833	1.215
	(9.979)	(4.390)	(9.100)	(4.686)	(5.812)	(3.508)	(15.86)	(4.349)
Repetition	-0.908		1.675		-1.577		-2.901	
	(3.719)		(3.132)		(2.457)		(6.288)	
Trading period (TP)	-0.390		0.174		0.388		-0.491	
	(1.123)		(1.325)		(0.520)		(2.270)	
Repetition $\times$ TP	0.057		0.126		0.078		0.428	
	(0.430)		(0.458)		(0.266)		(0.891)	
Period		-0.082		0.258		-0.041		-0.010
		(0.186)		(0.190)		(0.209)		(0.219)
Observations	233		227		199		221	
Number of groups	8		8		8		8	

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table F.4: Evolution of risk premium over time.

	(1)	(2)	(3)	(4)
	All	All	26–30	26–30
Constant (α)	1.042	88.19***	2.034	33.80
	(2.094)	(30.64)	(3.590)	(59.53)
Market (β_1)	0.008	−3.608	−1.642	−3.527
	(3.121)	(2.892)	(3.516)	(3.645)
SCinfo (β_2)	−1.982	1.321	−3.480	−4.666
	(1.617)	(4.480)	(4.241)	(5.133)
SCinfo × Market (β_3)	6.556**	11.11*	13.09***	20.72***
	(3.151)	(5.939)	(4.028)	(5.705)
Gender		−15.99**		−10.87*
		(5.714)		(6.536)
Age		−2.058		2.683
		(1.623)		(1.831)
Risk aversion		2.803**		3.946***
		(1.374)		(1.499)
Cognitive ability		1.002***		1.087*
		(0.249)		0.583
Machiavellianism		−0.268		−0.714**
		(0.218)		(0.324)
Competitiveness		0.312*		0.558**
		(0.164)		(0.268)
Optimism		−1.745**		−2.657**
		(0.696)		(1.046)
Openness (B5)		3.742**		1.310
		(1.734)		(1.392)
Conscientiousness (B5)		−3.662***		−5.390***
		(0.989)		(1.000)
Extraversion (B5)		1.492		3.552**
		(1.440)		(1.388)
Agreeableness (B5)		−1.876		0.209
		(2.941)		(0.970)
Neuroticism (B5)		−5.793***		−8.342***
		(1.144)		(1.268)
$\beta_1 + \beta_3$	6.564*	7.502**	11.448**	17.193***
p-value test $\beta_2 + \beta_3 = 0$	0.073	0.041	0.044	< 0.001
$\beta_2 + \beta_3$	4.574	12.431***	9.610*	16.054***
p-value test $\beta_2 + \beta_3 = 0$	0.195	< 0.001	0.063	< 0.001
Observations	880	779	152	134
Number of groups	32	28	32	28

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table F.5: Random effects OLS regression including controls from post-experimental questionnaire (averaged for matching groups).

controls. Including the controls from the questionnaire also improves statistical significance, despite a loss of observations due to missing questionnaire variables for one session (see Appendix D).

Comparing odd and even columns suggests that multicollinearity does not seem too much of an issue. Table F.6 shows pairwise correlation coefficients between questionnaire variables at the individual level across all treatments ($n = 140$). The table shows that generally correlation coefficients tend to be small and statistically insignificant. A few variables are significantly correlated however: men tend to be less risk averse ($\rho = -0.270$), more competitive ($\rho = 0.317$) and less neurotic ($\rho = -0.344$) than women. In addition neuroticism is positively correlated with risk aversion and negatively with optimism and extraversion. Machiavellianism is negatively correlated with optimism and agreeableness. At the matching group level only three of these correlations survive as statistically significant: the negative correlation between neuroticism and gender and optimism, respectively and the negative correlation between agreeableness and machiavellianism. Overall, Table F.6 together with the fact that effect sizes and direction of our main variables are not affected too much by including questionnaire variables make us confident that multi-collinearity is not too much of a problem in the regression displayed in Table F.5. The condition number for all thirteen variables reported in Table F.6 is 81.5692, which is below the cutoff of 100 mentioned in Cameron and Trivedi (2005).

|	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
gender (a)	1											
age (b)	0.165	1										
risk aversion (c)	−0.270*	−0.036	1									
Machiavellianism (d)	0.112	−0.027	−0.052	1								
competitiveness (e)	0.317*	0.026	−0.192	0.113	1							
optimism (f)	0.064	0.032	−0.067	−0.235*	0.118	1						
openness (g)	0.091	0.015	−0.076	0.035	0.162	0.058	1					
conscientiousness (h)	−0.218	0.015	−0.014	−0.068	0.177	0.189	0.198	1				
extraversion (i)	−0.025	−0.109	−0.136*	0.033	0.159	0.006	0.451	0.221*	1			
agreeableness (j)	0.023	0.024	−0.094	−0.292*	−0.013	0.163	0.057	0.257*	0.118	1		
neuroticism (k)	−0.344*	−0.064	0.236*	0.050	−0.172	−0.552*	0.006	0.013	−0.140*	0.072	1	
cognitive ability (l)	−0.039	−0.060*	−0.149	0.083	0.083	0.112*	0.076	−0.042	−0.014	0.091	0.010	1

* indicates significance at the 1% level.

Table F.6: Pairwise correlation coefficients between questionnaire variables at the individual level across all treatments.

G Additional Figures

Figure G.1 shows the risk premium over time for the two different signal distributions. The figure illustrates a pattern noted in Table F.2 in Appendix F: with SC information risk premia are higher in the market compared to the nonmarket condition. This effect is obtained under both signal distribution, but is stronger under ρ_2, where more participants receive a pair of signals suggesting that the high risk asset yields higher returns.
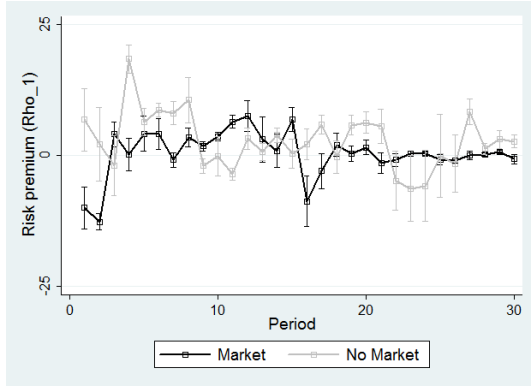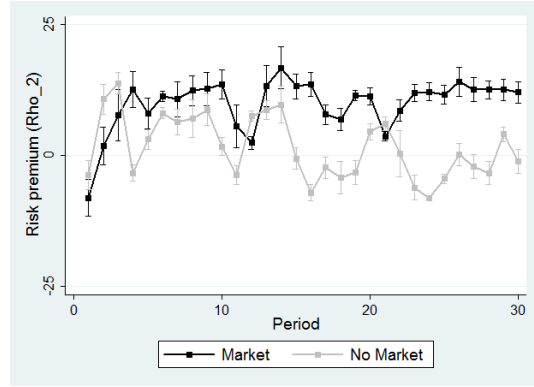

(a) without SC info; signal distr ρ_1
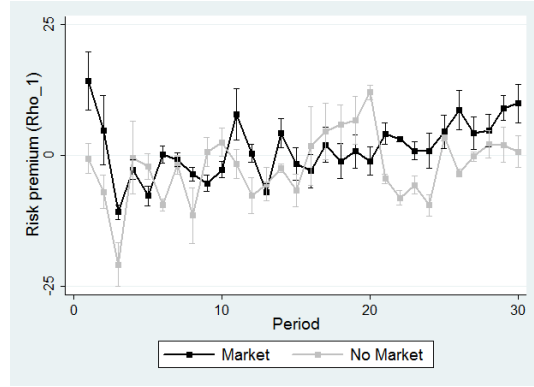
(b) with SC info; signal distr ρ_1
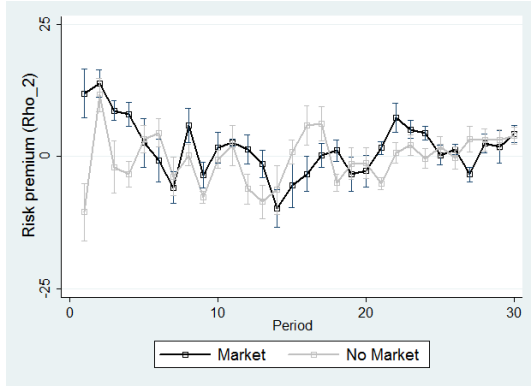
(c) without SC info; signal distr ρ_2

(d) with SC info; signal distr ρ_2

Figure G.1: Risk premium for different signal distributions.

H Social Comparison in Markets

We build on the model of reference dependent preferences developed by Kőszegi and Rabin (2006). Following Schmidt et al. (2015), we then incorporate a social comparison reference point into the model. Consider an agent i facing a lottery with K outcomes x_k and associated probabilities p_k $(k = 1, \ldots, K)$. We denote by r_ℓ $(\ell = 1, \ldots, L)$ the agent's social comparison reference point and consider a probability distribution $p_{k\ell}$ over pairs (x_k, r_ℓ). Let the agent's utility V be given by

$$V = \eta \left[\sum_k p_k\, u(x_k) \right] + \psi \left[\sum_{k,\ell} p_{k\ell}\, v(u(x_k) - u(r_\ell)) \right]. \tag{2}$$

The term in the first pair of squared brackets is the expected (consumption) utility of the gamble (asset) held, where we assume u to be concave. The parameter η is the weight on consumption utility and ψ captures the weight on gain–loss or social comparison utility. Following Kőszegi and Rabin (2006), we assume that v is continuous, strictly increasing and steeper for losses than for gains. In our market setting with five agents, two assets and each agent possibly holding multiple units of each assets, the space of possible pairs (x_k, r_ℓ) (as well as the number of possible definitions of r_ℓ) is quite big. In order to understand how social comparison affects the risk premium in markets it suffices, however, to consider a simple trade between two agents i and j where the high risk asset (HR) is swapped for the low-risk asset (LR).

Assume player i holds the high risk asset and player j the low risk asset, then i's utility is given by

$$
\begin{aligned}
V_i^{\mathrm{HR}} \;=\; & \eta\, EU^{\mathrm{HR}} + \psi \Big[\tfrac{7}{25} v(0) + \tfrac{6}{25} v\left(u(50) - u(100)\right) + \tfrac{2}{25} v\left(u(50) - u(150)\right) + \tfrac{1}{25} v\left(u(100) - u(50)\right) \\
& + \tfrac{1}{25} v\left(u(100) - u(150)\right) + \tfrac{2}{25} v\left(u(150) - u(50)\right) + \tfrac{6}{25} v\left(u(150) - u(100)\right) \Big].
\end{aligned}
$$

For the low risk asset the expression can be obtained analogously. The risk premium RP should then equal

$$
\begin{aligned}
RP \;=\; & V_i^{\mathrm{LR}} - V_i^{\mathrm{HR}} \\
\;=\; & \eta \left(EU^{\mathrm{LR}} - EU^{\mathrm{HR}} \right) + \psi \Big[\tfrac{5}{25} \Big\{ v\left(u(100) - u(50)\right) - v\left(u(50) - u(100)\right) \\
& \qquad\qquad\qquad\qquad + v\left(u(100) - u(150)\right) - v\left(u(150) - u(100)\right) \Big\} \Big].
\end{aligned}
$$

Or, when denoting $y = u(100) - u(50)$ and $x = u(150) - u(100)$,

$$RP \;=\; \eta \left(EU^{\mathrm{LR}} - EU^{\mathrm{HR}} \right) + \tfrac{1}{5} \psi \left[v(y) - v(-y) + v(-x) - v(x) \right],$$

where $y \geq x > 0$ by concavity of u. The term in the squared brackets is nonnegative if v is linear or strictly convex in the loss domain and concave in the gains domain.[1] Hence, RP is increasing in ψ. And, hence, the risk premium defined as $V_i^{\mathrm{LR}} - V_i^{\mathrm{HR}}$ is increasing in ψ.

---

[1] Because of loss aversion we know that $|v'(x)| < |v'(-x)|$. Convexity in the loss domain means $|v'(x)| < |v'(-y)|$.

In other words, in markets where trades make outcomes negatively correlated, the risk premium will increase in the extent to which participants care about social comparison. In the nonmarket treatments, where risks are idiosyncratic, social comparison information should not affect risk premia, which is consistent with our evidence (Schmidt et al., 2015). Consistently with this social comparison explanation, we also find that participants are less eager to hold assets at all: Both assets are priced lower with market interactions (Table F.3 in Appendix F). At this point it should be noted that not any trade in markets implies negative correlation of risk. Depending on their portfolio, market participants can swap different assets to reduce risk for both (Gortner and van der Weele, 2019). In our setting, however, this is not possible. Any trade of a given asset does necessarily involve negative correlation.

Some other possible mechanisms seem worth pointing out. First, reference-dependent preferences with probability weighting (Tversky and Kahneman, 1992) have been linked with a preference for positively skewed securities (Barberis and Huang, 2008). Such a mechanism, however, cannot explain any of our treatment differences, because it should operate in the same way in the market and nonmarket condition and with and without social comparison information. Second, while in the BDM the distribution of prices is uniform, in the market this is typically not the case. This differences in the distributions of prices could lead traders to be perceived as more risk averse in the market setting under non-expected utility theory Machina (1982). However, we study risk premia comparing high and low risk assets and it is not clear why they should be affected by this difference. Moreover, we find that markets lead to increased risk aversion if and only if social comparison information is provided; distributional differences alone cannot account for this effect.

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