Illusion of Expertise in Portfolio Decisions: An Experimental Approach*

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Abstract

This paper focuses on egocentric biases in financial decisions. Subjects first design a portfolio, whereby each combination of assets yields the same expected return and variance of returns. They are then confronted with two alternative portfolios; the average portfolio and the portfolio of one's selected expert. Illusion of expertise prevails if one prefers nevertheless the own portfolio. Using the random price mechanism reveals that most subjects prefer their own portfolio to the average or the expert's portfolio. Illusion of expertise is shown to be stable individually, over alternatives, and for both elicitation methods, willingness to pay and to accept.

Keywords: Investment decisions; Portfolio selection; Egocentric biases; Overconfidence; Experimental economics

JEL-Classification: C91, D80, D84, G11

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1 Introduction

Psychological evidence suggests that individuals are prone to egocentric biases, such as overconfidence, unrealistic optimism, and illusion of control. This evidence is supported by a substantial body of literature, which has only recently been considered in financial decision making (see Barberis and Thaler 2001, Hirshleifer 2001, for surveys).

In April 2002 an Australian stock broker has been ordered by the Victorian Supreme Court to pay compensation after losing a client's money during the process of "managing" it. The judge said that the broker had "an unrealistic view of his own ability" (Maiden and Lampe 2002, p.4). Also Nick Leeson, who was the chief derivatives trader at Barings bank in Singapore before bringing it down, overestimated his abilities by thinking he could outperform the market even after severe losses. "I was determined to win back the losses [...] I was well down, but increasingly sure that my doubling up and doubling up would pay off..." (Leeson 1996, pp.63-64).

Overconfidence, one exponent of egocentric biases, is regarded as one of the most robust findings in the psychology of judgment (e.g., DeBondt and Thaler 1995), and can be defined as a systematic overestimation of the accuracy of one's decisions and the precision of one's knowledge (e.g., Alpert and Raiffa 1982, Fischhoff et al. 1977, Lichtenstein et al. 1982). Overconfidence has been observed in many professions (see Yates 1990), and is positively related to the personal importance of a task (Frank 1935).

Psychological research also indicates that individuals tend to be unrealistically optimistic about the future. They judge positive traits to be overwhelmingly more characteristic of self than negative attributes (Alicke 1985, Brown 1986). Similarly, positive personality information can be recalled more quickly than negative information (Kuiper and Derry 1982). Most people also show poorer recall for information related to failure than to success (Silverman 1964), and rate past task performance more positively than it actually was (Crary 1966). Additionally, individuals were found to credit themselves for past success, and blame external factors for failures (Fischhoff 1982, Langer 1975), possibly to preserve an otherwise endangered self-image. People do also believe their chances of success at a random task to be greater than objectively justified; this tendency is referred to as illusion of control (Langer and Roth 1975). Individuals, for instance, simply believe they can skillfully influence and control outcomes of chance events.

In financial decision making egocentric biases have been both studied analytically and empirically. The model by Daniel et al. (1998), for instance, predicts that (i) overconfidence implies excess volatility, and that (ii) investors overreact to private signals

and underreact to public information signals.[1] Odean (1998b) emphasizes that overconfidence (i) increases expected trading volume, (ii) increases market depth, and (iii) decreases the expected "utility" of traders. Gervais and Odean (2001) ascertain that levels of overconfidence are greatest for inexperienced traders. By analyzing more than 10,000 individual accounts at a large discount brokerage house, Odean (1999) demonstrates that, on average, investors sell securities that outperform those they purchase. Kirchler and Maciejovsky (2002) compare two different and independent measures of overconfidence in the context of an experimental asset market and show that overconfidence increases with experience, but is moderated by the methodology used. Dittrich et al. (2001) demonstrate in an individual investment experiment that overconfidence (i) increases with the absolute deviation from optimal choice, (ii) increases with task complexity, and (iii) decreases with uncertainty.

In two recent empirical studies the importance of psychological factors on financial decision making has been successfully documented: Barber and Odean (2001) investigate the performance of investors who switched from phone-based trading to internet trading. While those traders who opted for internet trading initially beat the market by about 3% prior to going online, their performance decreased after going online, resulting in a performance of 2% below the market. In line with the predictions of theoretical models on overconfidence (e.g., Benos 1998, Odean 1998a), online investors traded too aggressively and less profitably.[2] Barber and Odean (2001) conclude that investor overconfidence is augmented by illusion of knowledge, in the sense of becoming more confident when given more information.

In a further empirical study, Benartzi and Thaler (2002)[3] confronted subjects investing in pension funds with the projected range of retirement income resulting from (i) their own portfolio, (ii) the average (median) portfolio, and (iii) a professional portfolio picked by an investment company. According to the subjective attractiveness of portfolios the authors find that the majority of survey participants prefer the median portfolio and the professional portfolio to the self-selected one, even though they initially rather formed their own portfolio instead of accepting the one designed for them by the professional investment manager. While the authors interpret their results in terms of investor autonomy, concluding that the value of choosing one's own portfolio does not

1 Such a model could, however, require a global game approach (Heinemann et al. 2002).

2 However, there are also models showing that overconfidence survives (e.g., Gervais and Odean 2001, Hirshleifer and Luo 2001).

3 We only learnt about this study after completion of our experiment.

seem to be great, the findings can also be interpreted in terms of overconfidence, leading to ambiguous evidence.[4]

In empirical studies based on field evidence, the researcher usually faces a trade off between external validity and internal control. While field evidence more closely mirrors behavior in a natural environment, laboratory research allows for more precise identification of structural relations. If field research identifies egocentric biases, the result may be driven by a variety of factors like superior information or skills, preventing the researcher from drawing straightforward conclusions. In this study we exclude both possibilities. In addition, we employ an incentive compatible mechanism to elicit preferences. By using laboratory research methods we (i) provide subjects with identical (and complete) information, and (ii) create a situation in which superior skills do not apply.

In particular, "being better than others" is experimentally ruled out by ensuring that all possible choices yield the same expected outcome. By employing the random price mechanism we elicit the participants' evaluations of their self-selected and of two alternative portfolios, the average group portfolio and the portfolio of an individually selected "expert".[5] Since all three portfolios yield the same expected return and variance of returns, individuals with μ, σ–preferences should be indifferent between any portfolio, irrespective whether the portfolio was chosen by themselves or by others.[6] We thus control for possible quantitative differences with respect to the portfolios.[7]

Reluctance to give up, respectively eagerness to obtain, the individually selected portfolio in favor of an equally good alternative one – or, more liberally, the tendency to prefer own choices much more than objectively justifiable – is referred to as "illusion of expertise". This definition requires not only that one prefers the self-selected portfolio to the alternative ones, but also that this preference is objectively unjustified and can be costly. There can be many reasons for illusion of expertise like overestimating one's knowledge or abilities, illusion of having more control in self-determined risky choice or an

4 While subjects preferred both the median and the expert's portfolio to their own, indicating underconfidence, the subjects pool consisted only of those who initially opted for creating their own portfolio, indicating overconfidence. Thus, the overall classification remains unclear.

5 In our setting, being selected as an expert, of course, does not necessarily imply superior skills in stock picking. However, also empirical evidence on the performance of professional investment advisors, brokers, etc. is ambiguous. Some studies cast doubt on the superior performance of mutual-fund managers (Jensen 1968) and recommendations by investment letters (Metrick 1999), whereas other studies report that analysts appear to have superior stock picking abilities (Womack 1996).

6 The assumption of μ, σ–preferences in experimental investigations on portfolio decisions and on empirical tests of the capital asset pricing model (CAPM) are standard, since both, portfolio theory (Markowitz 1952) and the CAPM, are based on quadratic utility functions.

7 Benartzi and Thaler (2002) report that individual and average (median) as well as individual and professional portfolios differed.

intrinsic liking of the self-chosen alternative. The central aspect, however, remains that one prefers the self-selected alternative even if this is costly and objectively unjustified.

Our results indicate that 64% of the participants are reluctant to switch from their self-selected portfolio to the average group or expert's portfolio, thereby exhibiting illusion of expertise. Furthermore, illusion of expertise is individually stable, both with respect to the average group portfolio and the expert's portfolio, and appears in both elicitation methods, asking for the willingness to pay and the willingness to accept. Participants, however, do not discriminate between the average group and their expert's portfolio.

The paper is organized as follows. In section 2 we describe the experimental setup. Section 3 presents the results, and in section 4 we summarize and discuss our main findings.

2 The experiment

2.1 Participants

Overall, 72 undergraduate students, mainly of economics and business administration, at the Humboldt-University of Berlin participated in six sessions with 12 participants each. Each session comprised three groups of four participants. Average earnings amounted to €10.04 ($SD = 4.87$). The time required to conduct the experiment was about 65 minutes. Twenty-seven females and 45 males, aged 19 to 29 ($M = 22.44, SD = 3.40$), participated in the experiment.

2.2 Experimental design and procedure

The experiment consisted of two phases: in the first phase participants were asked to complete a short decision task. In the second phase they made their investment decisions. Only the second phase was repeated once. The exact sequence of events of the computerized (using z-Tree; Zurich Toolbox for Readymade Economic Experiments; Fischbacher (1999)) experiment is shown in Figure 1.

Insert Figure 1 about here

Phase I: After privately reading the instructions, participants completed a short decision task, involving four analytical decision tasks, three financial knowledge tasks, and two self-ratings (see Appendix B for an English translation of the decision task).

The four analytical problems required (i) to complete a numerical series, (ii) to reason deductively, (iii) to compute conditional probabilities, and (iv) to decide in the Wason selection task (see e.g., Wason 1966, 1968). The three financial knowledge questions concerned the correct definition of (i) market maker, (ii) convertible bond, and (iii) zero-bond. Both, the analytical and the financial knowledge tasks were presented as multiple-choice questions with four response alternatives each. Additionally, participants were asked to (i) rate their expertise and (ii) their experience on a nine-step scale. Participants were granted a bonus of 10 Experimental Currency Units (ECU)[8] for each correct answer. No bonus was given for the two rating tasks. Participants were not informed about the correct answers. The time required for conducting phase I ranged from 15 to 20 minutes.

Phase II: This phase consisted of two identical periods. In each period participants were randomly assigned to groups of four and were endowed with 1,250 ECU each. Participants could invest their endowment in four risky assets. In each period 1,000 ECU were granted as (interest free) credit and were deducted from subjects' earnings at the end of the experiment. An English translation of the instructions are to be found in Appendix C.

Participants were informed that their portfolios could consist of any combination of assets and cash. A non-invested residual endowment earned zero-interest. The assets were denoted by A, B, C, and D. The future prices of the assets were state-contingent, whereby the probability of state x, y and z was 1/3 each. Participants were presented with purchase prices, future prices, and associated probabilities of the various states. In addition, they were informed that the four assets were perfectly positively correlated. Table 1 displays the purchase prices, the state-contingent future prices, the expected returns, and the variances and standard deviations of returns for the four assets.[9]

Insert Table 1 about here

The asset parameters were chosen such that expected returns of all four assets, and their variances (standard deviations) are identical. Since assets are perfectly positively correlated any possible combination of the four assets into a portfolio without cash results in equal expected returns and equal variances (standard deviations) of returns. Correspondingly, individuals with μ, σ–preferences should be indifferent between any

8 The exchange-rate for ECU was 80:1, that is 100 ECU equal €0.60.

9 The rates of return are computed as $(\frac{F-P}{P}) \cdot 100$, whereby F denotes the state-contingent future prices and P the purchase prices.

allocation of assets, regardless whether the portfolio was selected by themselves or by others (see Appendix A for a proof).[10]

After participants made their investment decisions, they could request up to four responses to the decision task by their three other group members. Then, participants were asked to select the other group member with the highest perceived expertise in financial matters (their"expert").

Subsequently, participants were instructed about the random price mechanism (Becker et al. 1964), which was used to elicit portfolio evaluations. To control for the endowment effect[11], participants were randomly assigned to the willingness-to-pay treatment and the willingness-to-accept treatment.[12] Endowment effects are most likely triggered by decision inertia implying reluctance to depart from initial endowment. More specifically, decision inertia in the willingness-to-pay treatment would result in negative bids, whereas in the willingness-to-accept treatment it would result in positive asks. On the contrary, illusion of expertise predicts positive bids and asks, respectively in both treatments.

In the willingness-to-pay treatment participants were asked to bid their maximum purchase price p from the interval -100 to +100 ECU to buy their self-selected portfolio; otherwise they obtained the average group portfolio and the expert's portfolio, respectively. For both alternative portfolios their bids were then compared to a randomly selected price $p^\star$.[13] In case of $p \geq p^\star$ the participant bought his/her self-selected portfolio at the cost of $p^\star$, otherwise (s)he obtained the alternative portfolio at no cost (see Table 2).

Insert Table 2 about here

In the willingness-to-accept treatment participants were asked to state their minimum selling price p from the interval -100 to +100 ECU at which they are willing to switch from their self-selected portfolio to the alternative portfolio. Their asks for both alternative portfolios, the average group and the expert's portfolio, were then compared to a randomly determined price $p^\star$, again between -100 and +100. In case of $p \leq p^\star$, the

10 While the assumption of quadratic utility functions is employed in the capital asset pricing model as well as in portfolio selection theory (Markowitz 1952), such a restriction is not strictly necessary. Levy and Markowitz (1979) demonstrate for various utility functions and empirical return distributions that this causes little harm.

11 The endowment effect refers to the tendency that individuals demand more for giving up an object than they are willing to pay for acquiring it (Kahneman et al. 1991).

12 Prior experimental evidence indicates lower willingness to pay than to accept (see e.g., Hoffman and Spitzer 1990, Knetsch and Sinden 1984).

13 Since incentive compatibility does not require knowledge of the distribution of the random price, participants were not informed that $p^\star$ is selected according to the uniform density.

participant switched to the alternative portfolio and received the randomly determined price, otherwise (s)he kept his/her self-selected portfolio at no compensation (see Table 2).

In case of μ, σ–preferences the optimal bids and asks p^{opt} should be 0, regardless whether the alternative is the group average or the expert's portfolio. Illusion of expertise prevails if one is willing to pay positive prices for buying the self-selected portfolio or requires a positive compensation in order to give it up. Similarly, low confidence in one's decisions is revealed by one's willingness to keep or buy the own portfolio only when being compensated by negative prices.[14]

For evaluating portfolios subjects were presented with the self-selected as well as with the alternative portfolios on the same screen. Figure 2 shows the computer screen for evaluations in the willingness-to-pay treatment. Asset holdings were displayed in fractions of total investments including cash holdings. Thus, the investment fractions displayed in Figure 2 add up to 100%. In order to ensure that evaluations are not affected by different underlying risk attitudes, the proportion of assets to cash of the two alternative portfolios was the same as of the individually selected portfolio.

Insert Figure 2 about here

After choosing their minimum purchase price and their maximum selling price, respectively for both alternative portfolios it was independently determined which portfolio participants obtained. Thus, participants either held (i) twice their self-selected portfolio, (ii) their self-selected portfolio and the average group portfolio, (iii) their self-selected portfolio and the expert's portfolio, or (iv) the average group portfolio and the expert's portfolio. Then, the future prices of the assets were determined by randomly selecting one of the states x, y or z. Finally, participants were informed about their payoff. Phase II was repeated once. Total payoffs included the payoffs from both portfolios held at the end of each period. From the proceeds of their four portfolios the total credit amount of 4,000 ECU (1,000 ECU per each of the four portfolios) was deducted. The time required for conducting phase II was about 40 to 50 minutes.

14 In view of the debate inspired by Harrison (1992) one might be interested in not only comparing deviations from optimality in action space (actual and optimal bids) but also in payoff space. This, however, would require knowing the density of the random price mechanism. Thus, at least from the perspective of a participant the payoff loss could not be estimated. In our view, this questions the argument that suboptimality only matters when it implies substantial losses.

3 Experimental results

In this section we report the results (i) of the decision task, involving analytical tasks, financial knowledge, and self-declared expertise and experience in financial matters, (ii) of requests for such answers to the decision task in order to select one's expert, and (iii) of illusion of expertise in the portfolio decisions.

3.1 Analytical skills, financial knowledge, and self-declared expertise and experience

The overall percentage of correct answers in the decision task was 58.54%. In the analytical part of the decision task 64.4% of the answers were correct, whereas in the financial knowledge part this proportion was only 50.47%. According to Table 3 no participant managed to solve all seven problems correctly, and nobody failed in all seven problems. The majority of participants solved four (33.33%), five (29.17%), and three problems (15.28%) correctly.

Insert Table 3 about here

Generally, participants achieved higher solution rates in the analytical decision task – with exception to question 4, the Wason selection task[15] which only four participants managed to solve correctly (see Table 4).[16] The highest solution rates were achieved for the deductive reasoning task (88.9%), followed by the compound lottery task (87.5%), and the numerical series task (76.4%). Concerning the financial knowledge task participants found it most difficult to identify the correct definition of "market maker".[17]

Insert Table 4 about here

Average self-rating of expertise in financial matters was 4.83 ($SD = 2.15$), and average rating of personal experience in financial matters was 3.54 ($SD = 2.66$) with

15 As we did not explicitly state that on each card there is a letter on one side and a number on the other side, the correct answer includes the "K"-card additionally to the "E"- and the "7"-card, because turning it over could yield a vowel as well. Taking this into account we find only one subject who gave the accurate answer, raising the total number of subjects who gave an acceptable answer to five. Sixty-two participants turned the "E"-card (86.1%), 39 turned the "2"-card (54.2%), and 13 participants turned the "K"-card (18.1%) and the "7"-card (18.1%), respectively.

16 Cognitive errors in the Wason selection task are shown to be persistent also on competitive markets (**?**).

17 Only 22 participants out of the 72 (or 30.6%) managed to correctly solve this task. The frequencies of correct answers for the definitions of "convertible bond" and "zero-bond" were 41 and 46 out of 72 participants, or 56.9% and 63.9%, respectively.

both rating scales ranging from 1 = "I do not agree" to 9 = "I fully agree". According to the Spearman correlation analysis self-declared expertise and experience are both positively correlated with the number of correct answers in the prior decision task ($\rho(72) = .37, p < .001; \rho(72) = .43, p < .001$): the higher the self-declared expertise or experience the larger the number of correct answers. Thus, we feel confident that our task selection seems appropriate to identify financial expertise.

3.2 Information requests for expert selection

Participants could request up to four answers to the prior decision task by the three other group members in each of the two periods in order to select their "expert". The overwhelming number of participants exploited the potential of four possible requests in both periods.[18] Overall, the number of requested answers increased from period 1 to period 2, from 256 to 269 requests.

According to Table 5, participants were mostly interested in the self-rating with respect to individual experience (question 9). In period 1, this request was followed by two questions from the financial knowledge set, "market maker" and "zero-bond" (questions 5 and 6). Thirty-nine participants requested question 5, and 35 participants requested question 7, which was actually only correctly answered by 22 participants. Participants were also interested in the answers to the compound lottery task (question 3) and to the numerical series task (question 1). In period 2, again self-declared experience (question 9) was most frequently requested, followed by the numerical series task (question 1), the definitions of "market maker" and "zero-bond" (questions 5 and question 7), and the self-declared expertise of the participants (question 8).

Insert Table 5 about here

Table 6 displays the frequency of requests with respect to position of requested answers to the decision task and period. The most frequently requested questions at position I in both periods were the self-declared experience (question 9) and the numerical series task (question 1). At position II, participants most frequently requested answers to the deductive reasoning task (question 2) in period 1, and to the compound lottery task (question 3) and the self-declared expertise in financial matters (question 8) in period 2.

Insert Table 6 about here

18 More precisely, 59 participants requested four answers, 3 requested three, 1 requested two, and 9 participants requested one answer in period 1. In period 2, 63 participants requested four answers, 3 requested three, 2 requested two, and 4 participants requested one answer.

So far we have focused on which kind of information was requested by subjects in order to select their expert. It remains to investigate if subjects made use of their information. To answer this question we compare the observed probability of being selected as an expert to the expected probability of selecting randomly. Since the observed probability of being selected as an expert once, twice or three times is significantly different from random our experimental manipulation seems to be successful (see Table 7): Participants did not select their experts on a random basis.

Insert Table 7 about here

Our findings thus indicate that subjects relied mostly on self-ratings in the process of information acquisition as indicated both by the frequency and the position of the requests. Also, answers to the financial knowledge task were considered of importance. However, these requests were made rather late in the information acquisition process. We also find that selecting one's expert was not a random decision.

3.3 Illusion of expertise

Participants were confronted with the average group portfolio as well as with their individually selected expert's portfolio. Since all possible combinations of assets into a portfolio yield the same expected return and variance of returns a positive bid for purchasing as well as a positive ask for selling the own portfolio indicates illusion of expertise. Conversely, a negative bid for purchasing as well as a negative ask for selling indicates low confidence in one's decisions. Only bids and asks of zero indicate indifference between the individually selected portfolio and the alternative portfolios.

In Figure 3 the bids and asks (pooled over periods) with respect to the average group portfolio and the expert's portfolio are presented. Bids and asks range from -100 to +100 and are combined into classes of equal width. The mode was the highest possible bid and ask. Generally, the distribution of observed prices is skewed to the left, indicating that there is a systematic preference for the self-selected portfolio, even if this decision reduces the subjects' payoffs. However, Figure 3 also indicates that many subjects were indifferent between the portfolios and some exhibited even underconfidence.

Insert Figure 3 about here

If instead of the distribution of bids and asks, our classification of prices into three categories, illusion of expertise, underestimation and well-calibration, is analyzed a similar picture emerges. Figure 4 shows that the majority of bids and asks across the two

periods, with respect to the average group portfolio as well as with respect to the individually chosen expert's portfolio, reflects illusion of expertise.

Insert Figure 4 about here

More specifically, the results suggest that participants are more prone to illusion of expertise with respect to the expert's portfolio than with respect to the average group portfolio. However, Figure 5 indicates that subjects did not discriminate between the expert's and the average group portfolio in the first period ($\chi^2 = 0.39, p = .52$). In the second period the degree of illusion of expertise was weakly higher with respect to the expert's portfolio than with respect to the average group portfolio ($\chi^2 = 3.60, p = .06$).

Insert Figure 5 about here

One explanation for this result in the second period might be that the experts' portfolios are less diversified than the average portfolio. If this is true, subjects who are confronted with an expert's portfolio that is less diversified[19] than the average portfolio should more likely be prone to illusion of expertise than those subjects who are confronted with equally well diversified alternative portfolios. In fact, 32 (44.4%) out of the 72 participants were confronted with an expert's portfolio that was less diversified than the average portfolio, whereas for the remaining 40 subjects (55.6%) the expert's and the average portfolio were equally well diversified. However, in contrast to the conjecture, the fraction of subjects who exhibit illusion of expertise with respect to the expert's portfolio is even weakly lower in the first group than in the latter (65.5% versus 80%, Binomial-Test: $z = 1.37, p = .08$). Thus, poorer diversification does not explain the higher degree of illusion of expertise with respect to the expert's portfolio.

If one pools the bids and asks for the two alternative portfolios, 63.89% of the participants can be classified as being prone to illusion of expertise, 19.79% as having low confidence in their decisions, and only 16.32% as well-calibrated. If one substitutes $p = 0$ by $p \in (-\varepsilon, +\varepsilon)$ well-calibration increases to 21.9% for $\varepsilon = 10$.

To control for the endowment effect, participants were asked for their willingness to pay and their willingness to accept as a between-subjects factor. Table 8 shows the overall results and allows differentiating between the two different treatments. As expected, prices in the willingness-to-accept treatment are significantly higher than those in the

19 One portfolio is less diversified than another if it consists of one asset type $(A, ..., D)$ less. Consider the following two portfolios: $P_1 = (2A, 3B, 0C, 1D)$ and $P_2 = (3A, 2B, 0C, 0D)$. According to our definition we refer to P_2 as less diversified than P_1.

willingness-to-pay treatment, for the average group portfolio as well as for the expert's portfolio (see Table 9).

Insert Table 8 about here

Insert Table 9 about here

If our results were driven only by the endowment effect, triggered by decision inertia, we would expect negative bids in the willingness-to-pay treatment and positive asks in the willingness-to-accept treatment. On the contrary, illusion of expertise predicts positive bids and asks, respectively in both treatments. Table 10 indicates that overall, median bids and asks are positively shifted and significantly different from zero, except for the willingness-to-pay treatment in evaluating the average group portfolio. Still, due to the high number of well-calibrated evaluations in this case the lower boundary of the confidence interval is zero and not negative. These findings indicate that our data cannot be explained by the endowment effect. The systematic shift of observed bids and asks supports our notion of illusion of expertise. Individuals prefer their individually selected portfolio to the alternative ones. However, in line with previous experimental evidence (e.g., Hoffman and Spitzer 1990, Knetsch and Sinden 1984), we find that the same question, once presented in terms of willingness to pay and once presented in terms of willingness to accept, triggers different individual responses. In general, participants are less willing to pay than they are willing to accept.

Insert Table 10 about here

On an individual level and pooled across the two periods, 53 participants (73.6%) are classified as being constantly well-calibrated, underconfident, or prone to illusion of expertise with respect to the average portfolio. For the remaining 19 participants (26.4%) their evaluations and thus their classifications changed. Similar results hold for the expert's portfolio. Again 53 participants are classified as being constantly well-calibrated, underconfident, or prone to illusion of expertise, whereas for 19 participants their evaluations changed from period 1 to 2. Regarding both alternatives still 42 participants (58.3%) are classified as being constantly well-calibrated, underconfident, or prone to illusion of expertise, whereas for the remaining 30 participants (41.7%) the evaluations and therefore also their classification changed at least once.

By comparing the two periods, the individual stability of illusion of expertise is much higher than the stability of well-calibration or of low confidence (Table 11). The vast majority of participants can be classified as being constantly prone to illusion of expertise both in period 1 and in period 2. Thirty-eight (88.4%) out of the 43 participants whose evaluations concerning the average portfolio indicated illusion of expertise in period 1 were also prone to this bias in period 2, whereas for the remaining 5 participants (11.6%) their evaluations changed. Similar results hold in case of the expert's portfolio: 41 (95.3%) out of the 43 participants whose evaluations indicated illusion of expertise in period 1 were also prone to this bias in period 2, whereas for only 2 participants (4.7%) their evaluations changed.

Insert Table 11 about here

Considering the positive bids and asks across the two periods and for both the average group and the expert's portfolio 15 participants never submitted positive prices, 3 participants submitted one positive price, 12 participants two positive prices, 11 participants three positive prices, and the remaining 31 participants submitted positive prices in all four situations. Let us finally consider those subjects who submitted at least one positive bid or ask, i.e. 57 cases. Out of these cases 31 subjects (54.39%) persistently revealed positive prices in all four observations, justifying the conclusion that most participants are prone to illusion of expertise. This finding suggests that illusion of expertise does not occur accidentally – once, twice or three times out of four possible situations – but systematically, and more importantly seems to be individually stable.

4 Discussion

If someone claims to have more, less or average competence one usually faces the difficulty that individuals rely on different aspects when judging their competence. In the well-known self-ranking of car driving (Svenson 1981) superior car driving skills can be, for instance, judged by years without accident, by how fast one can safely drive etc. Thus, the fact that 93 percent of the American students considered themselves as more skillful drivers than others could simply reflect that people rely on different ideas of what accounts for being a good driver.

In this paper we avoided such ambiguity by employing a financial setting with a well-defined decision aspect, namely the composition of one's portfolio. While field data on egocentric biases cannot account for quantitative differences in portfolios and/or superior

skills, our experimental approach rules out "being better than others". We (i) provided subjects with identical (and complete) information, and (ii) created a situation in which superior skills do not apply. More precisely, we investigated the participants' evaluations of their individually selected portfolio and of two alternative portfolios, the average group and the portfolio of an individually selected "expert". Since all three portfolios yield the same expected return and variance of returns, individuals with μ, σ–preferences should be indifferent between any combination of assets, irrespective whether the portfolio was picked by themselves or by others.

Our main findings can be summarized as follows: Illusion of expertise is verified and shown to be stable, individually (in period 1 *and* 2), over alternatives (for the average *and* the expert's portfolio), and for both ways of eliciting evaluations (willingness to pay *and* to accept). According to our classification, based on the random price mechanism, on average two thirds of all evaluations reveal illusion of expertise, whereas well-calibration is nearly as frequent as low confidence in period 1 and is even less frequent in period 2. The majority of individual evaluations reveal illusion of expertise in both periods and for both alternatives, indicating that illusion of expertise does not occur accidentally but systematically. Apparently, individuals favor their own portfolio choice over alternative ones, even though this cannot be justified objectively. Thus, our results partly run counter to the findings of Benartzi and Thaler (2002), who report that the majority of survey participants prefer the median portfolio as well as the portfolio picked by an investment company to the one they picked themselves. In their study, however, subjects did not know with which alternative they were confronted; all alternatives were neutrally labelled.

The results of our study have important implications for financial decision making. First, egocentric biases can account for systematic overestimation of one's portfolio performance and might lead to serious misinvestments and to spectacular financial crashes. Second, egocentric biases seem to be stable personality traits which might be explicitly addressed by financial professionals. Knowing about these biases and developing tools to identify and categorize types of investors might allow to create better tailored financial products. Third, it is important to engage investors actively in investment decisions. Financial professionals are recommended to seize suggestions and requests by clients in order to increase personal identification and acceptance.

Limitations of our study could be seen in the experimental procedure of eliciting one's expert: we did not provide the possibility to (i) select oneself as an expert, and (ii) to elect no expert at all. One might also argue that the prior decision task and the

portfolio choices are not closely linked. The positive correlation between self-reported expertise and solution rates in the decision task questions the criticism that participants considered the decision task as somehow loosely connected with the investment task.

Future research should not only focus on individual investment behavior but also allow for market interaction and learning. In addition, the relation between investment behavior and personality traits, such as attribution styles and risk attitude, may be explored.

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Appendix A

The optimal portfolio P maximizes the ratio of excess return (expected return minus risk-free rate) to the standard deviation, subject to the constraint that the sum of proportions invested in the assets equals 1, i.e. the slope of the capital market line has to be maximized under the given constraint, or formally:

$$max \frac{R_p - R_f}{\sigma_p} \text{ s. t. } \sum_i X_i = 1 \tag{1}$$

R_f denotes the risk-free rate of lending and borrowing, R_p the expected return on the portfolio, σ_p the standard deviation of the return of the portfolio, and X_i denotes the fraction of investor's funds invested in asset i.

Given four assets with equal expected returns, equal standard deviation of returns ($R_i = R_k, \sigma_i = \sigma_k \; \forall \; i, k = 1, ..., 4$), and perfect positive correlation between all assets ($\rho_{ik} = +1 \; \forall \; i \neq k$) the expected return of the portfolio P is:

$$R_p = \sum_i X_i R_i = R_i \text{ with } \sum_i X_i = 1 \tag{2}$$

Further, the variance of returns for the portfolio P is:[20]

$$\begin{aligned} \sigma_p^2 &= \sum_i X_i^2 \sigma_i^2 + \sum_i \sum_k X_i X_k \sigma_{ik} = \\ &= [\sum_i X_i \sigma_k]^2 \\ &= \sigma_k^2 \end{aligned} \tag{3}$$

Thus, the expected return and the standard deviation of returns on the portfolio do not depend on the particular fractions X_i invested. Every feasible allocation of the four assets results in a portfolio P with identical expected return and variance. Therefore for μ, σ–preferences every asset allocation yields an optimal outcome, i.e. participants should be indifferent between any allocation of the four assets.

20 Note that: $\sigma_{ik} = \sigma_i \sigma_k \rho_{ik}$ with $\rho_{ik} = +1$, thus $\sigma_{ik} = \sigma_i \sigma_k = \sigma_k^2$.

Appendix B

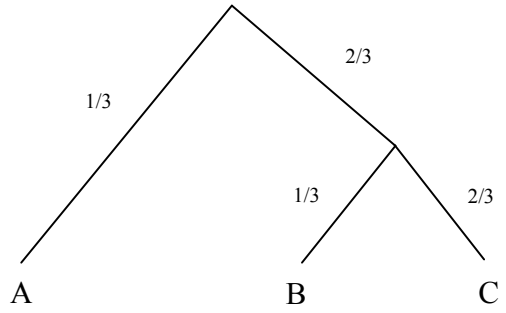
1: The following numerical series obeys a linear rule. According to next number = α*(previous number)+β. Please complete the following numerical series:
1 2 5 14

a) 45
b) 15
c) 41
d) 28

2: Please verify which of the following conclusions can be unambiguously derived from the two premises.
All As are Bs
All Bs are Cs

a) No C is A
b) All As are Cs
c) Some Bs are Cs
d) All Cs are Bs

3: In the following decision tree either A is reached with a probability of 1/3, or a random draw decides whether B is reached with a probability of 1/3 or C is reached with a probability of 2/3. Which of the following paths is most likely?



a) The path to A is most likely
b) The path to B is most likely
c) The path to C is most likely
d) All paths are equally likely

4: Please verify the following rule: "If there is a vowel on one side of the card, then there is an even number on the other side". Which card(s) do you have to turn at most in order to test it?

a) E b) K c) 2 d) 7

5: What is a market maker?

a) Institutions or organizations that guarantee the smoothly dealing in stocks.
b) Market participants who quote binding bids and offer prices for shares.
c) Trading activity of enterprises with large market shares.
d) Brokers and investment houses that issue new shares.

6: What is a convertible bond?

a) Bonds that can be converted into a predetermined amount of the company's equity at certain times during its life.
b) Temporary right on a bond to accept or reject a quoted bid or ask.
c) Bonds issued by an investment bank that certifies the holder the right to convert into a pre-specified investment fund at certain times during its life.
d) Special kind of stocks that certifies the holder the right to convert into a predetermined amount of bonds.

7: What is a zero-bond?

a) Bonds and fixed-interest securities that hold limited risk.
b) Bonds that in contrast to shares do not certify the right of membership, but the right of equity and of liquidity.
c) Bonds and fixed-interest securities with limited opportunity of profits.
d) Bonds that pay no interest, instead they are redeemed at maturity for their full face value.

8: In financial matters I trust in my own abilities.

I do not agree										I fully agree
	1	2	3	4	5	6	7	8	9	

9: I am experienced in stock dealing.

I do not agree										I fully agree
	1	2	3	4	5	6	7	8	9	

Appendix C

Thank you for participating in our experiment!

The experiment deals with individual decision making.

Your responses will be dealt with anonymously and will not be handed over to third parties.

For your participation in the experiment, you will be financially rewarded, depending on your decisions. During the experiment all amounts are quoted in ECU. At the end of the experiment you will obtain the corresponding amount cash in DM. The exchange rate is 80:1, that is 100 Experimental Currency Units (ECU) equal DM 1.25. The time required is about 1 hour.

On the screen, you will be asked to answer a few questions. For each correctly solved question you will obtain 10 ECU, which will be paid out to you at the end of the experiment. Seven out of the 9 questions are multiple-choice-questions, whereas the remaining 2 questions should be answered on a rating scale. For these 2 questions you will not obtain any financial reward.

The experiment lasts for two periods. In each period, you will get an endowment of 1,250 ECU. From your endowment you cannot invest more than 1,000 ECU in the four assets A, B, C, and D. You can invest in assets of the same type or in assets of different types. Thus, you can choose any possible combination of assets. The amount not invested will be subject to a zero-interest rate, and will be added to your earnings from the experiment.

Each of the assets has a certain purchase price and three possible future values, which depend on the states x, y and z. Each of the three states has the same probability. The purchase price of the assets will be deducted from your earnings at the time of purchase. The future value of the assets will be determined at the end of each period and will be added to your total earnings.

In the following table you will find the purchase price of the assets and the corresponding possible future values.

Asset	State	Probability	Purchase price	Future value
A	x	1/3	60	45
	y	1/3		70
	z	1/3		80
B	x	1/3	48	36
	y	1/3		56
	z	1/3		64
C	x	1/3	72	54
	y	1/3		84
	z	1/3		96
D	x	1/3	96	72
	y	1/3		112
	z	1/3		128

The future values of the assets are dependent from one another. That is, if state x occurs, this state determines the price of the assets A, B, C and D. The same is true for the other states, y and z.

The difference between your wealth at the end of the period and the 1,000 ECU, you could have invested, determines your earnings. Your earnings of both periods, plus your earnings from the questionnaire, will be paid out to you at the end of the experiment.

In the following you will be assigned to a group consisting of 4 members. Groups will be randomly determined at the beginning of each of the two periods. There is a positive possibility that you will meet one or more of your group members more than once.

Instead of selecting a portfolio on one's own, people often invest in funds, hoping that these funds are adequately allocated and will yield higher returns than one's own portfolio. In order to offer you a similar possibility you can

- inform yourself about the responses to the questionnaire of the three other group members. Whereby you cannot request more than **4** responses.
- then elect the one of your group members with the highest perceived competence in portfolio decisions. This member is referred to as your expert.

You should carefully answer the last question, because your earnings may depend on the decisions of your group members and on the decisions of your elected expert. You will get twice the possibility, to switch from your self-selected portfolio to an alternative portfolio. Both alternative portfolios consist of the same proportion of cash than your self-selected portfolio. That is, the only difference to your self-selected portfolio is the allocation of assets.

The two alternatives are:

- first, the average portfolio of all four group members. We refer to the first alternative as the average group portfolio
- second, the portfolio of your individually elected expert, that is the person you nominated as the one of your other three group members with the highest perceived competence in portfolio decisions. We refer to the second alternative as the expert's portfolio.

Treatment: Willingness to Pay

How can you buy your individually selected portfolio?

You must now state your maximum purchase price p for each of the two alternative portfolios, which you are willing to pay, in order to buy your self-selected portfolio. Otherwise you will obtain the alternative portfolio. For your decisions you will get a budget of 200 ECU. You can choose your purchase price from the interval –100 to +100. Your specified price p will be compared to a randomly determined price p^*, which is also drawn from the interval - 100 to +100.

You can buy your individually selected portfolio if:
$p \geq p^*$, and pay p^* (that is, p^* will be deducted from your earnings).
You obtain the alternative portfolio if:
$p < p^*$, in this case nothing will be deducted from your earnings.

You must independently state your maximum purchase price p both with respect to the average group portfolio as well as to the expert's portfolio. After your decisions, the future values of the assets will be determined according to the states x, y and z. The net-earnings of both portfolios will be added to your total earnings and the period ends.

Treatment: Willingness to Accept

How can you sell your individually selected portfolio?

You must now state your minimum selling price p with respect to the alternative portfolios, which you are requiring, in order to sell your self-selected portfolio. You can choose your selling price from the interval –100 to +100. Your specified price p will be compared to a randomly determined price p^*, which is also drawn from the interval - 100 to +100.

You obtain the alternative portfolio if:
$p^* \geq p$, and obtain p^* (that is, p^* will be added to your earnings).
You keep your individually selected portfolio if:
$p^* < p$, in this case nothing will be added to your earnings.

You must independently state your minimum selling price p both with respect to the average group portfolio as well as to the expert's portfolio. After your decisions, the future values of the assets will be determined according to the states x, y and z. The net-earnings of both portfolios will be added to your total earnings and the period ends.

Figure 1: Sequence of events in the experiment

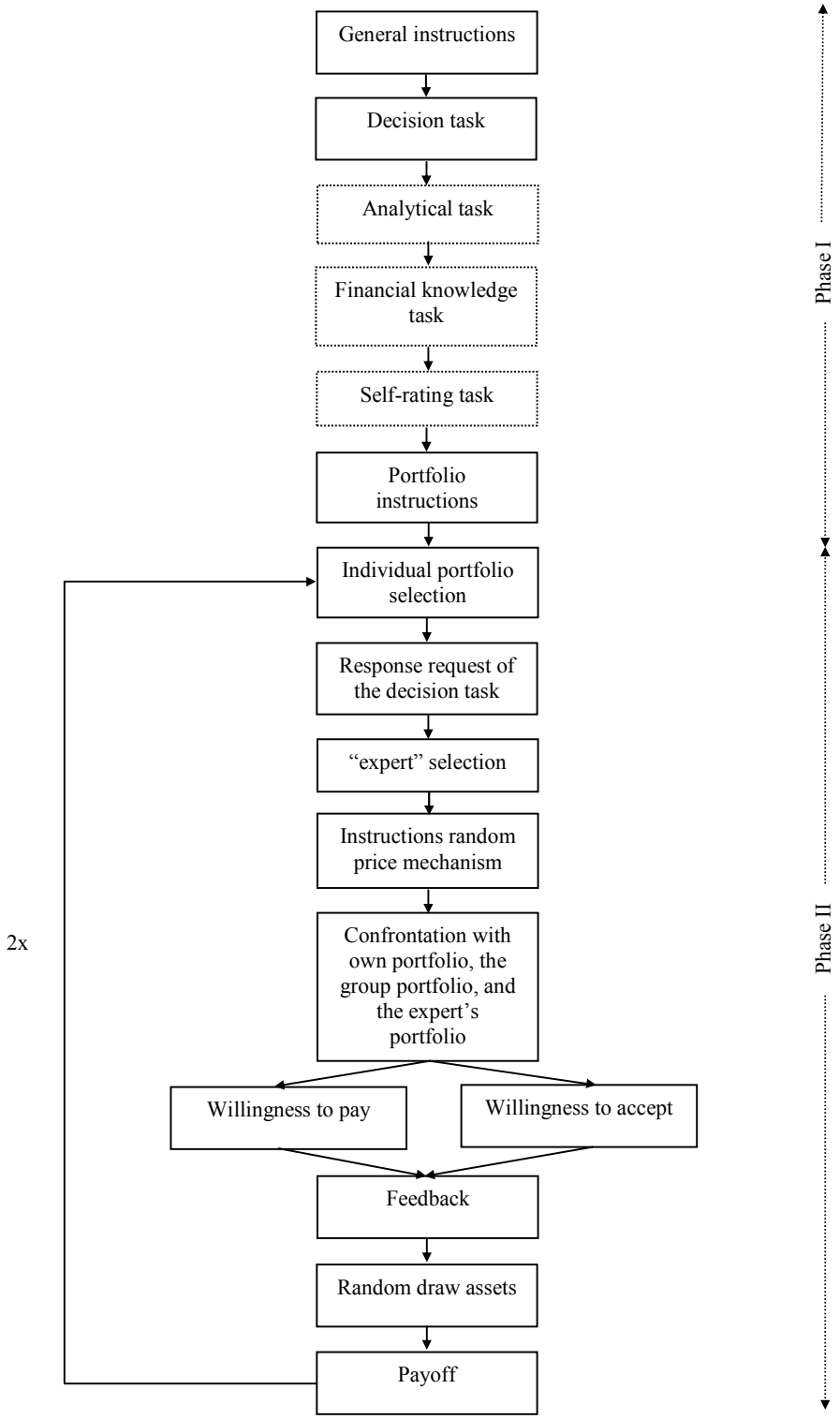


Figure 2: The computer screen for price choices in the willingness-to-pay treatment

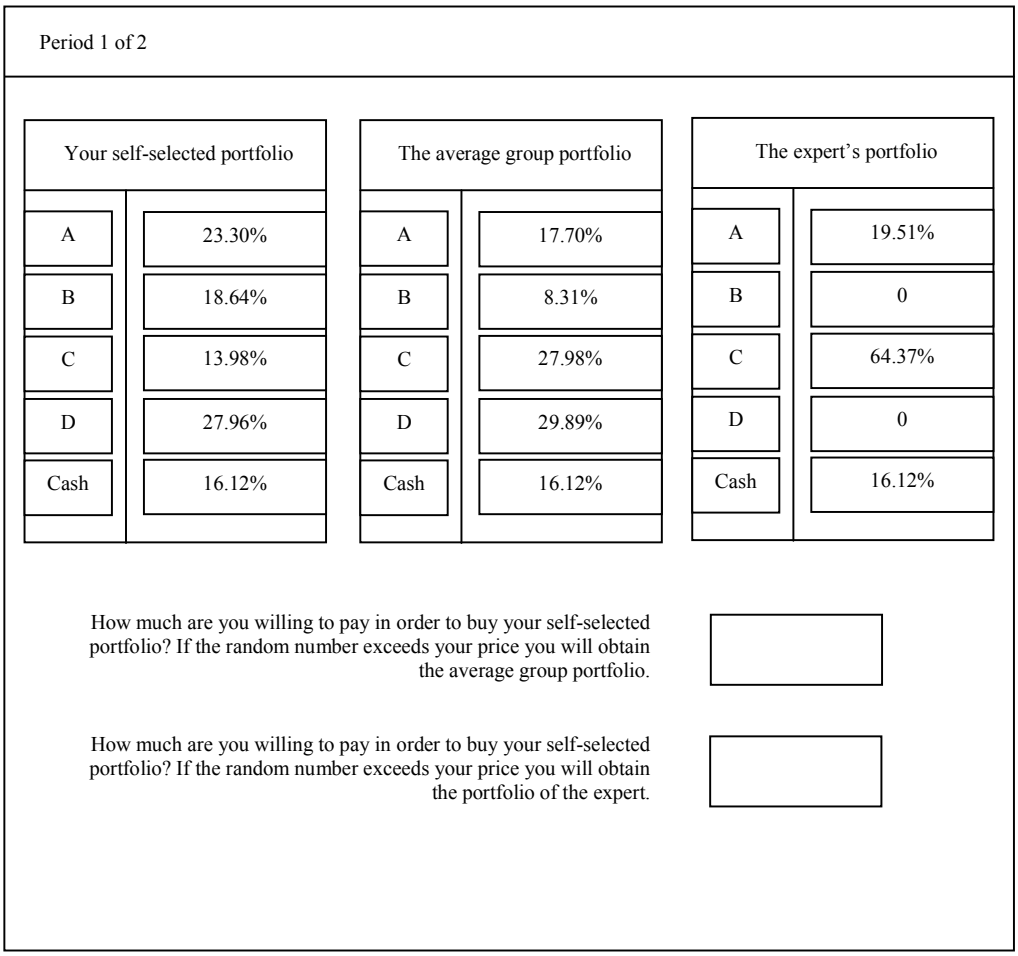


Figure 3: Frequency of pooled bids and asks with respect to the average and the expert's portfolio

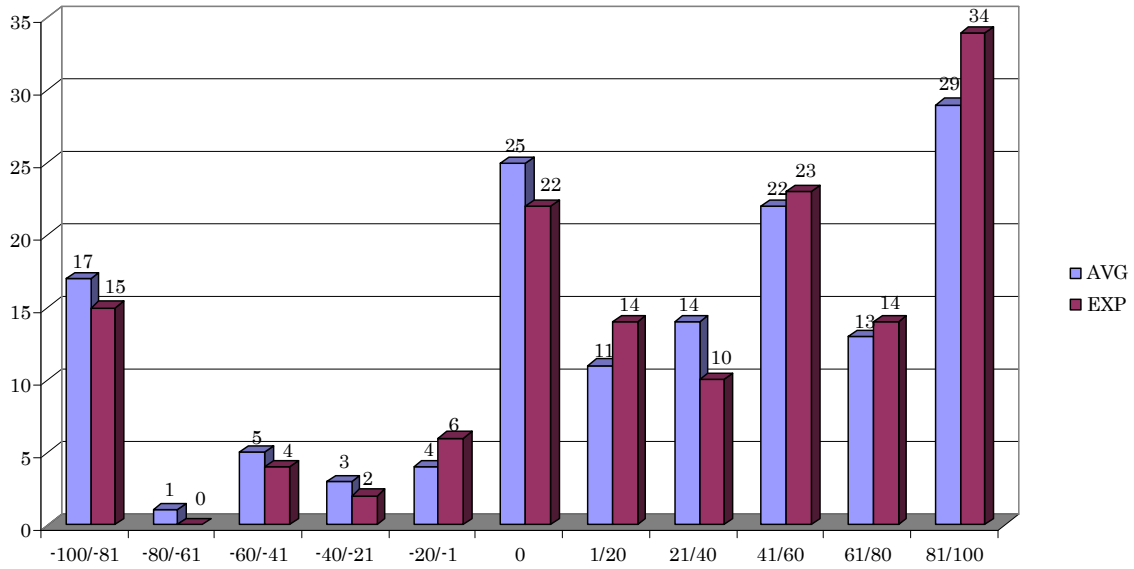


Figure 4: Percentage of well-calibrated and underconfident participants as well as of those exhibiting illusion of expertise with respect to the average group portfolio and the expert's portfolio

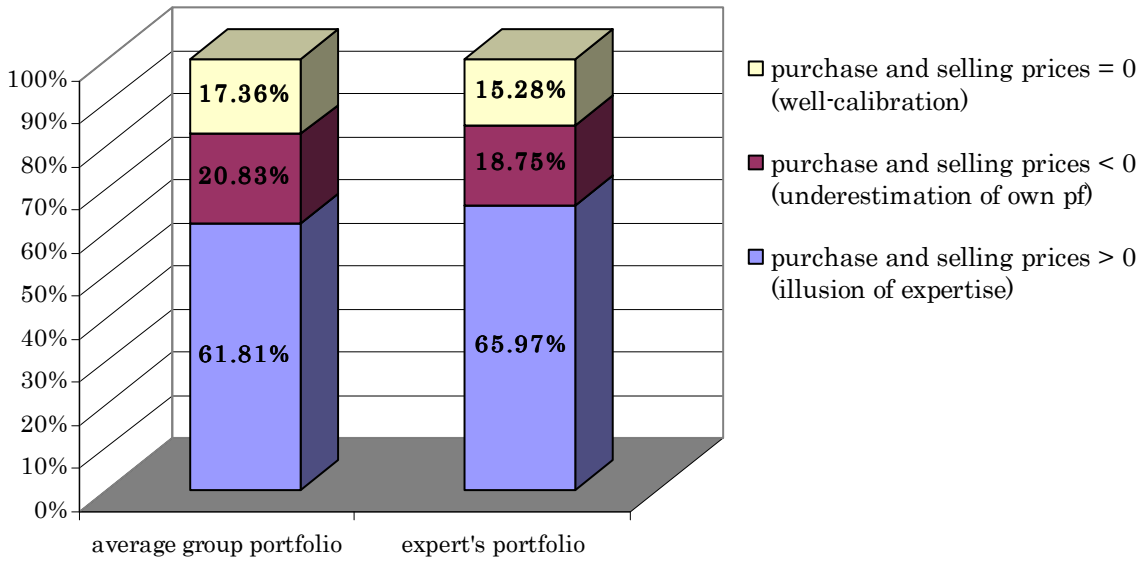


Figure 5: Well-calibration, underconfidence and illusion of expertise across periods

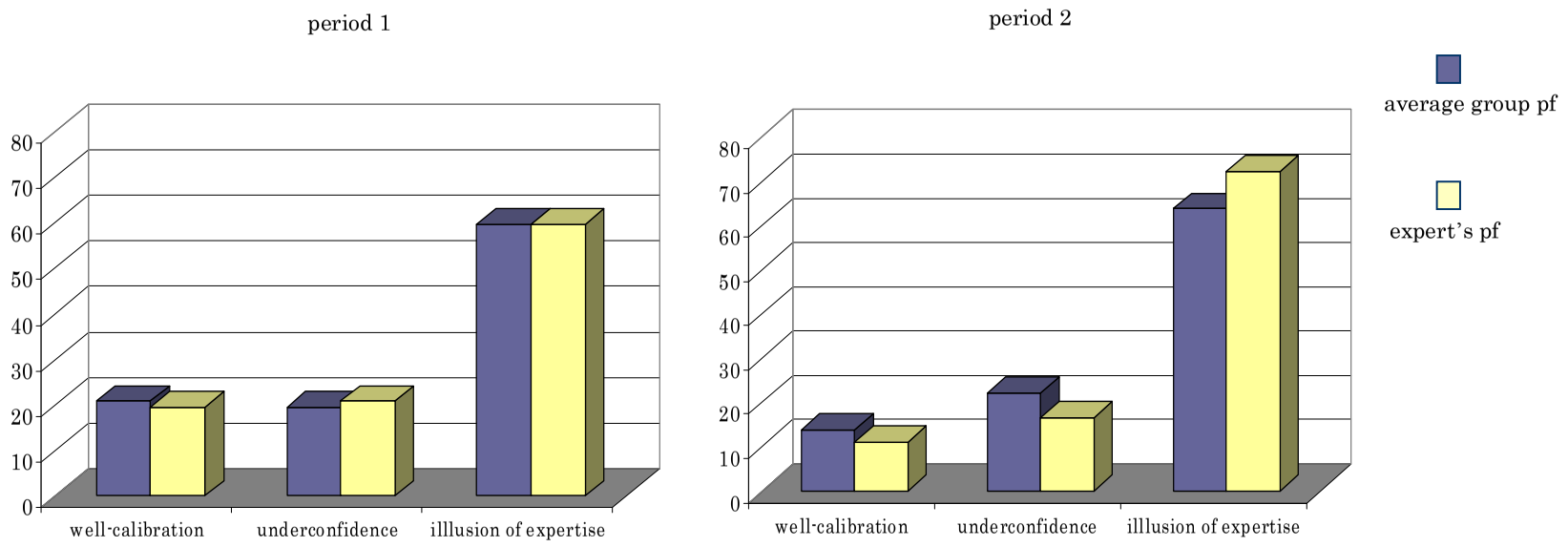


Table 1: Future prices of assets A, B, C, and D in ECU

Asset	State	Probability	Purchase price	Future price	Expected value of returns	Variance or returns	Standard deviation of returns
A	x	1/3	60	45	8.33%	6.02%	24.53%
	y	1/3		70			
	z	1/3		80			
B	x	1/3	48	36	8.33%	6.02%	24.53%
	y	1/3		56			
	z	1/3		64			
C	x	1/3	72	54	8.33%	6.02%	24.53%
	y	1/3		84			
	z	1/3		96			
D	x	1/3	96	72	8.33%	6.02%	24.53%
	y	1/3		112			
	z	1/3		128			

Table 2: The random price mechanism with respect to purchase and selling prices

		Keep the self-selected portfolio	Cost of
Maximum purchase price	$p \geq p^*$	yes	p^*
	$p < p^*$	no	0
Minimum selling price	$p \leq p^*$	no	$- p^*$
	$p > p^*$	yes	0

Table 3: Frequency and percentage of correct answers in the decision task

Number of correct answers	f	%
0	0	0
1	3	4.17
2	5	6.94
3	11	15.28
4	24	33.33
5	21	29.17
6	8	11.11
7	0	0

Table 4: Frequency and percentage of correct and incorrect choices in the analytical and the financial knowledge task

Decision task	Question	Frequency of		Percentage of	
		Correct answers	Incorrect answers	Correct answers	Incorrect answers
Analytical	1	55	17	76.4	23.6
	2	64	8	88.9	11.1
	3	63	9	87.5	12.5
	4	4	68	5.6	94.4
Financial knowledge	5	22	50	30.6	69.4
	6	41	31	56.9	43.1
	7	46	26	63.9	36.1

Table 5: Frequency and percentage of requested answers of the decision task in both periods

		Period 1		Period 2	
Decision task	Question	f	%	f	%
Analytical	1	31	12.11	34	12.64
	2	17	6.64	22	8.18
	3	34	13.28	27	10.04
	4	21	8.20	25	9.29
Financial knowledge	5	39	15.23	31	11.52
	6	21	8.20	28	10.41
	7	35	13.67	30	11.15
Self-rating	8	17	6.64	30	11.15
	9	41	16.02	42	15.61
	Total	256	100	269	100

Table 6: Frequency of requested answers of the decision task with respect to position and period

	Position I		Position II		Position III		Position IV	
Question	Period 1	Period 2	Period 1	Period 2	Period 1	Period 2	Period 1	Period 2
1	15	17	5	5	6	4	5	8
2	1	4	11	4	1	6	4	8
3	10	4	8	12	12	8	4	3
4	4	3	4	7	5	7	8	8
5	5	8	8	6	12	8	14	9
6	4	1	8	9	5	12	4	6
7	7	7	6	4	13	9	9	10
8	3	8	8	12	3	7	3	3
9	23	20	5	9	5	5	8	8

Table 7: Observed and expected probability of being chosen as an expert

	Observed frequencies		Observed probabilities		Expected	p-values	
Selected	Period 1	Period 2	Period 1	Period 2	probabilities	Period 1	Period 2
Never	28	26	0.389	0.361	0.296	0.08	0.11
Once	22	25	0.306	0.347	0.148	0.00 **	0.00 **
Twice	16	16	0.222	0.222	0.074	0.00 **	0.00 **
Three times	6	5	0.083	0.069	0.037	0.02 *	0.07

Note: ** denotes significant p-values at α=.01, and * denotes significant p-values at α=.05.

Table 8: Frequency and percentage of well-calibrated and of underconfident participants as well as of those exhibiting illusion of expertise with respect to the average group portfolio, the expert's portfolio, the willingness-to-accept-condition, the willingness-to-pay-condition for both periods

			Willingness to accept		Willingness to pay	
			f	%	f	%
Period 1	Average group portfolio	Well-calibrated	7	19.4	8	22.2
		Underconfident	1	2.8	13	36.1
		Prone to illusion of expertise	28	77.8	15	41.7
	Expert's portfolio	Well-calibrated	8	22.2	6	16.7
		Underconfident	6	16.7	9	25
		Prone to illusion of expertise	22	61.7	21	58.3
	Total	Well-calibrated	15	20.8	14	19.4
		Underconfident	7	9.7	22	30.6
		Prone to illusion of expertise	50	69.4	36	50
Period 2	Average group portfolio	Well-calibrated	6	16.7	4	11.1
		Underconfident	2	5.6	14	38.9
		Prone to illusion of expertise	28	77.8	18	50
	Expert's portfolio	Well-calibrated	6	16.7	2	5.6
		Underconfident	2	5.6	10	27.8
		Prone to illusion of expertise	28	77.8	24	66.7
	Total	Well-calibrated	12	16.7	6	8.3
		Underconfident	4	5.6	24	33.3
		Prone to illusion of expertise	56	77.8	42	58.3
	Overall total	Well-calibrated	27	18.75	20	13.9
		Underconfident	11	7.6	46	31.9
		Prone to illusion of expertise	106	73.6	78	54.2

Table 9: Mean ranks for the average group portfolio and for the expert's portfolio with respect to the willingness-to-pay-condition and to the willingness-to-accept-condition

	Average group portfolio		Expert's portfolio	
	Mean rank	Rank sum	Mean rank	Rank sum
Willingness-to-pay	59.37	4274.5	64.67	4656.5
Willingness-to-accept	85.63	6165.5	80.33	5783.5
z-Value	- 3.81		- 2.27	
p	< .001		< .05	

Table 10: Confidence intervals for median bids and asks with respect to the average group portfolio and the expert's portfolio

	Average group portfolio		Expert's portfolio	
	Median	Confidence interval	Median	Confidence interval
Willingness-to-pay (bids)	0	[0, 50]	30	[10, 50]
Willingness-to-accept (asks)	50	[35, 60]	50	[20, 70]

Note: The significance level for the confidence intervals is α=.05.

Table 11: Individual stability of well-calibration, underconfidence and illusion of expertise across the two periods

		Average group portfolio		Expert's portfolio	
Period 1	Period 2	f	%	f	%
Well-calibrated	Well-calibrated	7	46.7	5	35.7
	Not well-calibrated	8	53.3	9	64.3
Underconfident	Underconfident	8	57.1	7	46.7
	Not underconfident	6	42.9	8	53.3
Prone to illusion of expertise	Illusion of expertise	38	88.4	41	95.3
	No illusion of expertise	5	11.6	2	4.7