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The Performance of Groups and Individuals in Financial Decision-Making

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The Performance of Groups and Individuals in Financial Decision-Making

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Abstract

On financial markets many investment decisions are taken by groups and not by individuals. The evidence, however, whether groups perform better than individuals, is ambiguous. We analyze the portfolios of groups and individuals in an asset allocation task on an experimental market. We find that groups on average outperform individuals, i.e., achieve higher Sharpe ratios but the difference is not significant. However, there are also large performance discrepancies across groups and the best groups significantly outperform individuals. An important determinant of the success a group in our experiment is the degree of information exchange between group members as a higher level is linked to a significantly better performance.

Keywords: Group and Individual Decision-Making, Experiment, Laboratory, Hidden Profiles, Group Polarization

JEL-Classification: Laboratory, Individual and Group Behavior

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1. Introduction

Today many decisions in the domain of financial markets are taken by groups and not by individuals. For example, asset management firms often appoint management teams instead of single managers and institutional investors like pension plans elect boards of trustees to define the strategic asset allocation and investment committees to decide about tactical allocations. However, economic research so far has not put a lot of attention on differences between the outcome of individual and group decisions. One reason might be that many economic models assume the decision-maker to choose equilibrium (or optimal) actions, in which case it does not matter whether the decision-maker is an individual or a group (cf. Kocher and Sutter (2005)). If, however, decision makers are not as rational as assumed by classical decision making theory, we may encounter differences across the behavior of groups and individuals as Prather and Middleton (2002) explain. The contribution of this paper is a comparison of the performance of groups and individuals in an asset allocation task. To our knowledge this is the first study which analyzes this issue in a controlled laboratory experiment. On an experimental market a sample of individuals and a sample of groups were asked to build portfolios of 3 risky assets and 1 riskfree asset. Subjects were paid according to the Sharpe ratio of their portfolios, which is a simple performance measure that has its theoretical foundation in the capital asset pricing model (CAPM).[1]

We find that groups do not significantly but only marginally outperform individuals. A focus solely on the aggregate performance of groups, however, disregards the heterogeneity in our sample. There are large performance discrepancies between the best and the worst groups and these differences seem to be related to different procedures groups apply to agree on an asset allocation in our experiment. Recordings of the discussions

[1] The Sharpe ratio is the ratio between the excess return and the volatility of the portfolio.

within each group during the experiment allow us to judge how much information the group members exchanged and how they chose their asset allocation. In line with the hidden profile thesis of Stasser and Titus (1985) to be discussed below, the success of a group in the experiment is positively related to the level of information exchange across group members. So groups do not generally take better decisions than individuals but they have the potential to do so, if the group members exchange their personal views and ideas.

The rest of the paper is organized as follows. Section 2 provides an overview of related research about group decision making and section Section 3 outlines the design of our experiment and describes our experimental procedure. In Section 4 we present the results of our experiment and in section 5 we discuss our findings and conclude.

2. Related Research

The existing literature provides no generalized theoretical framework about the differences in judgments between groups and individuals in economic decision-making and the evidence from empirical studies is mixed. Nevertheless, research in psychology and economics offers various insights into the decision-making processes of groups and their performance relative to individuals. The psychological literature distinguishes between judgmental tasks and intellective tasks as outlined by Davis (1992). The former are characterized by not having an undisputable optimal solution whereas the latter typically have a self-confirming and easily demonstrable optimal solution. For example, a logic problem is an intellective task while a task in which subjective risk preferences are measured can be categorized as judgmental. The asset allocation task in our experiment clearly is an intellective one: first, because it has an optimal solution, which – in principal – can be calculated by each participant given the information we provide – and second, because the participants receive feedback about their performance after each round of the experiment, so there is the potential to find evidence about the success of a certain strategy. But we acknowledge that given the information we have provided in the experiment the calculation of the optimal portfolio is extremely demanding without a computer and very difficult to demonstrate ex ante. Hence, our task also bears some characteristics of a judgmental task.

Representative for the wide variety of results of judgmental tasks in psychology is Kerr et al. (1996), who provide a survey of empirical studies about decision-making of groups versus individuals. They point out that many differences with respect to the methodology, the group framing and the task processing make a meta-study almost impossible. The authors further note that the group decision-making process (for example majority voting, equilibrating or unanimous voting) is highly influential on the outcome as it can attenuate, amplify or reproduce the judgment biases of individuals.

The evidence in psychological research on intellective tasks is less multisided. Before 1955 it seemed clear that groups outperform individuals in intellective tasks as common sense would suggest (see Shaw (1932) for a classic experiment). But then Lorge and Solomon (1955) re-examined Shaw's classic study and introduced a new standard, called "truth-wins-standard", to measure the superiority of group versus individuals. According to this standard a group will find a correct solution to an intellective task if at least one group member proposes it. Hence, the larger the size of the group, the larger are the probabilities for synergies and the chances to solve the problem. The re-examination of Shaw's and other data revealed that groups rarely outperform individuals, sometimes match and usually fall below the truth-wins-standard (see Davis (1992)).

The debate about the performance of groups relative to individuals continues as more recent evidence from studies on intellective tasks is available. As far as rationality in the decision-making process is concerned, Yaniv and Bornstein (1998) show that groups tend to take more rational decisions than individuals, because the groups in their sample tendered lower offers and accepted lower bids in a one-shot ultimatum game. According to a study by Laughlin et al. (1998) about formulating hypotheses in an intellective task with playing cards, groups of four participants perform at the level of the best individual and therefore significantly above individuals' average. They argue that the group performance increases with task complexity and information variety as groups can better handle such issues. Rockenbach et al. (2006) report that groups achieve similar levels of expected payoffs with significantly lower risk than individuals when choosing between different lotteries. Bornstein et al. (2004) find that groups exit a centipede game significantly earlier than individuals which is more rational from a game theoretic perspective. Concluding, the authors point out that groups and individuals make different decisions in strategic games and that in a majority of the cases group decisions are closer to the "rational" solution. Counter evidence is offered by Cason and Mui (1997) who find that groups are more generous in a dictator game than individuals and are thus further away from the game-theoretic prediction. Kocher and Sutter (2005) report that groups learn faster than individuals in a beauty-contest game on an experimental market, but they point out that groups are neither smarter nor better decision-makers than individuals per se.

Cooper and Kagel (2005) report that groups of two persons tend to take more strategic decisions than individuals in a signaling game even if the truth-wins-standard is taken into account. Blinder and Morgan (2005) study a monetary policy game and find that groups tend to take better decisions than individuals. Interestingly, they discover no significant differences between majority decisions and unanimous decisions, as far as the groups' performance is concerned. By contrast, Lombardelli et al. (2005) report that groups achieve significantly better results than individuals in a policy making game on an experimental market and that groups even outperform the best individuals. They argue that the worst individual decisions are averaged out in the group and that the group members learn from each other. However, the opportunity to discuss the decision within the group did not enhance the performance relative to those groups, who were not allowed to discuss.

The results of empirical studies on real financial markets are in line with those from experimental markets as no robust differences between the performance of groups and individuals have been found so far. Barber and Odean (2000) report from a sample of 166 US investment clubs out of 78'000 trading accounts that the clubs lag the performance of the S&P 500 Index by 3.7% and the performance of individual investors by 2.3% after costs. However, they note that clubs' portfolios show on average lower monthly volatilities than individuals' portfolios - due to a higher degree of portfolio diversification - and therefore achieve a higher Sharpe ratio. In their sample of mutual funds Baer et al. (2005) find that funds managed by teams show lower levels of unsystematic risk. Such funds also change their risk to a lesser extent as a response to prior performance than funds managed by individuals. However, overall there is no significant difference between the performance of team managed funds and individually managed funds. Also Prather and Middleton (2002) find no significant difference between the performance of funds managed by individuals versus funds managed by a team even after taking expenses for the fund management into account.

The psychological literature has identified two main reasons for the fact that groups do not necessarily behave more rationally than individuals. One reason is given by "hidden profiles" according to which group members do not use all relevant private information in order to take a decision but rather focus on information that is both shared by all group members and that is in line with the general thinking of the group. Stasser and Titus (1985) report results from an experiment on a political voting game, where each group member received different but slightly overlapping information about candidates in the voting game. To find the best candidate, the group members had to share all available information, which most groups failed to do and hence they opted for the wrong candidate. Janis (1982) offers supportive evidence for the hidden profile effect. Based on studies about American foreign policy decisions since 1940 he concludes that a process for successful group decisions is characterized, among other things, by the rational weighting of possible options in the light of all available evidence. Those results imply that there might be differences with respect to the performance of groups in our asset allocation experiment because of different levels of information exchange across group members.

A second reason for the lack of group performance lies in the “group polarization effect.” Until the 60s it was widely believed that group decisions are more or less an average reflection of individual beliefs. Today this view is supported by the theoretical work of Sah and Stiglitz (1986) who argue that group decisions are less extreme and less volatile than individual decisions or by Moscovici (1985) who presents empirical evidence that group decisions may shift individual attitudes towards more moderate positions. In contrast, Stoner (1961) counters those predictions by describing the so called “risky shift” effect. It refers to the observation that groups do not moderate extreme positions of individuals after a discussion of the issue in a group but rather emphasize those extreme positions even more. Moscovici and Zavalloni (1969) generalized this line of thinking and introduced the “group polarization” effect. They argue that group polarization does not necessarily lead to risky shifts but can also lead to “cautious shifts”. Hence, following an information exchange between group members, a group's decision will be a more extreme version of an individual's preferred action, but it is not possible to say ex ante whether it will be riskier or more cautious.

3. Experiment

In the following section we introduce our experimental design and procedure.

3.1 Experimental Design

Our experiment consists of an asset allocation task with 3 risky assets and 1 riskfree asset. In order to make the experiment as realistic as possible the participants were not informed about the expected returns, volatilities and correlations of the assets. Instead, we defined 4 different but equally probable states of nature and specified returns for the assets in each state of nature (cf. the experimental design in Bossaerts and Plott (2002)). Table 1a contains a summary of the states of nature and the returns of each asset in those states. Obviously, expected returns and the covariance of returns between any two assets can easily be calculated from this data. The returns are chosen such that the expected returns of the assets are increasing in the volatility of the return. Hence, there are no dominated assets. Also, the correlation between the assets is rather low.

Depending on the choice of the subjects' rewards, the asset allocation problem is a judgmental or rather an intellective task. A judgmental task is obtained if, for example, subjects are paid according to the return of their portfolio. In this case individual risk attitudes do matter and it is difficult if not impossible to compare the performance across individuals and groups. Instead, we decided to reward subjects according to a performance measure that is independent of individual risk attitudes so that the asset allocation problem becomes an intellective task. We chose the Sharpe ratio as our performance measure for the following reasons: First, the ratio between the excess return and volatility is a simple and intuitive measure that can easily be explained to the subjects. Secondly, there is some evidence that people in an asset allocation task behave as if they were maximizing a mean-variance utility function, in which case it is optimal to choose a portfolio that maximizes the Sharpe ratio (see Bossaerts and Plott (2004)).

Maximizing the Sharpe ratio is equivalent to finding the tangency portfolio. To make this search challenging, we have chosen the returns of our assets such that the optimal solution is far away from either an allocation of 100% in one asset or an equally weighted allocation. In fact, as can be seen in Table 1b, the weights of the risky assets in the tangency portfolio are very asymmetric. This assures that it is hard to find the optimal portfolio by accident and that the odds are small that averaging out individual allocations across group members automatically leads to the optimal solution. Table 1b also contains the excess returns of the risky assets and the covariance matrix that is needed to calculate the tangency portfolio which maximizes the Sharpe ratio. The participants in our experiment did not receive any information from Table 1b.

3.2 Experimental Procedure

The computerized experiment was conducted at the University of Zurich in June and July 2007.[2] In total 93 students participated in our experiment, 43 female and 50 male, with ages ranging from 19 to 32.[3] 16 subjects studied economics at the University of Zurich, 27 were students from other fields at the University of Zurich and 50 were students from the Swiss Federal Institute of Technology (ETHZ). 45 students participated in the experiment as individuals and 48 as member of a group of 3 people. The groups were assembled randomly by letting the participants draw cards with different letters and building groups of subjects who had drawn cards with the same letters.

We had separate sessions for individuals and groups and the subjects were not allowed to choose whether to participate as an individual or as a member of a group. The experiments for the individuals were conducted in the laboratory of the Institute for Em-

[2] The experiment was programmed and conducted with the experimental software "z-tree" (see Fischbacher, U., 1999, z-tree. Toolbox for Readymade Economic Experiments, IEW Working Paper, University of Zurich.).

[3] The participants were recruited using the recruitment system ORSEE (see Greiner, B., 2004, The Online Recruiting System ORSEE 2.0. A Guide for the Organization of Experiments in Economics, Working Paper Series in Economics, Department of Economics, University of Cologne.).

pirical Research in Economics and the group experiments took place in the Swiss Banking Institute at the University of Zurich.

We conducted 2 sessions with the individual treatment (24, respectively 21 participants) and 4 sessions with the group treatment. In 3 sessions of the group treatment we had 5 groups and in 1 session we had 4 groups with 3 people each. There are no significant differences between participants in the individual and group treatment with respect to personal and observable characteristics like education, age, gender and personal interest in financial topics. Therefore, differences between the performance of individuals and groups in the experiments cannot be attributed to these personal characteristics.

In the individual treatment subjects were placed in front of computer terminals that were separated from each other so that they could not observe the actions of other participants. Moreover, subjects were not allowed to talk to each other during the experiment. In the group treatment each group was placed in a separate room. There was one computer in each room and subjects could freely decide which group member was supposed to operate the computer. Group members were allowed to communicate freely during the experiment. In order to analyze the impact of the level of information exchange in the group treatment, we recorded the discussions of each group.[4] The recording started with the distribution of the instructions of the experiment and it ended with the announcement of the results in the last round of the experiment. The participants were informed about the recording in advance.

In both, the individual and group treatment there was a test run and afterwards the asset allocation game was played for 15 rounds. In each round the participants had to choose an asset allocation, i.e. they had to assign weights to the four assets A, B, C and D which sum up to 100%. If the sum of the weights was different from 100% subjects received an error message and were asked to correct their assignment of weights. Sub-

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[4] The recordings (in Swiss German) are available from the authors upon request.

jects had 3 minutes in order to enter an asset allocation. If a subject failed to enter an allocation within this time limit, the computer automatically assigned 100% into the riskless asset, which, by definition, yields a Sharpe ratio of 0.

After every round each individual, respectively each group was informed about the mean return, the volatility and the Sharpe ratio of their portfolio in the current as well as in all past rounds. In addition every participant was informed about the highest Sharpe ratio a participant had achieved in each past round of the experiment. This feedback allowed the participants to better judge about the quality of their own allocation. As the performance of (successful) competitors on financial markets is usually at least partly observable, the feedback also gives a realistic flavor to our experiment.

The experiment including instructions and the completion of the questionnaires lasted for about 70 minutes (40 minutes for the experiment only) in the individual and about 75 minutes in the group treatment (45 minutes for the experiment only). Subjects were paid according to the average Sharpe ratio they achieved in all 15 rounds of the experiment.[5] Also we paid a bonus for the winning group in each group experiment and for the best four individuals in each individual experiment. The bonus was 10 Swiss francs (approximately 6.50 Euro) for each member of the best group in the group treatment and 20 Swiss francs (approximately 13 Euro) for the best individual, respectively 10 Swiss francs for the second, third and fourth best individual in the individual treatment. The average payout per participant was 38.5 Swiss francs (approximately 25 Euro) for the sample of groups and 37.5 Swiss francs for the sample of individuals.

Before the experiment was started, subjects received a detailed instruction (see Appendix I for a translation of the original German instructions for the individual treatment). To make sure that every participant fully understood the tasks in the experiment subjects had to answer a questionnaire (see Questionnaire I in Appendix II for an English

[5] The payment was 30 times the average Sharpe ratio.

translation). The experiment did not start until each participant in each session had successfully completed the questionnaire, which took approximately 20 minutes in each session. To gather more information about the participants' experience as a group member or as an individual a second questionnaire (see Questionnaire II in Appendix II for an English translation) was distributed after the last round of the experiment. Observe that hidden profiles are dampened in our group treatment to a certain extent because we provided everybody with the same set of information as every participant received the same instructions. With this information every participant was in a position to find the optimal solution herself. Hence, the defining characteristics of a hidden profile according to Schulz-Hardt and Greitmeyer (2003) do not exist in our experimental design. However, the groups still face a special sort of a hidden profile effect: If the group members do not share their personal opinions and ideas about how to weight the different assets, they might agree on a bad allocation simply because no group member could solve the problem but nevertheless allows his personal view to prevail.

4. Results

In the following section we present the results of our experiment.

4.1 Performance Comparison between Individuals and Groups

We start by comparing the Sharpe ratios obtained by individuals and groups and check if there is a significant difference in each round and across the whole experiment.[6] Figure 1a shows the average and Figure 1b the median Sharpe ratio for individuals and groups per round in our asset allocation experiment. The maximum Sharpe ratio to be

[6] 3 out of 19 groups have been excluded from the analysis because by some organizational mistake some group members had already completed the experiment as individuals. Their experience as individuals positively biased the overall results of those groups because they already knew the optimal allocation. As we reported the best Sharpe ratio to all participants in a given session, one may suspect that having a biased group also biased the whole session. A Mann-Whitney test confirmed, however, that there is no significant difference at the 10% level in all but one round between group experiment sessions with and without experienced group members. So we are confident that the exclusion of those groups does not affect the results of all the other groups in any way.

achieved in each round of our experiment is 0.923 (see Table 1b). It can be seen that groups achieve higher Sharpe ratios on average (and in the median) than individuals in 13 (15) rounds.[7] A Mann-Whitney test, however, reveals that groups do not significantly outperform individuals, as the difference between the achieved Sharpe ratio of groups and individuals is not significant at the 5% level in any round. The Z scores of Mann-Whitney tests across all 15 rounds of the experiment range from -1.46 to -0.16 and the average is only -0.86 so we cannot reject the hypothesis that there is no difference between individual and group performance.

Furthermore, Figures 1a and 1b reveal that both groups and individuals learn on average because the average and median Sharpe ratios are increasing in the majority of rounds. For individuals (groups) we observed 10 (9) increases on average and 11 (9) in the median. Since there is no significant difference between the Sharpe ratios of groups and individuals in any given round, there is no indication that groups learned faster than individuals or vice versa. As expected learning effect is larger in the first half of the experiment than in the second half as can be seen in Figures 1a and 1b, and there is no single group and only one individual who performs better in the first round than in the last round.

An equal weighting of the risky assets in our experiments yields a Sharpe ratio of 0.724. In Figure 1a we see that groups on average achieved higher Sharpe ratios already in the first round, whereas individuals slightly underperformed this benchmark of naive diversification. But from the second round on both samples perform on average

[7] The results in this paper are based on different experimental sessions which might not allow for an aggregation of results from different sessions. The reason is that the Sharpe ratio of the best participant was shown to all other participants in a session in each round of an experiment. Moreover, theoretically the odds of having a lucky participant who starts with a very good allocation is significantly higher in the individual treatment with 24 individuals than it is in the group treatment with only 5 groups, so the feedback participants received in the different treatments might have been different. But there is one reason which invalidates this argument. We observed that in each group experiment at least one group achieved very high Sharpe ratios during each round of the experiment. Hence, the feedback was almost identical for all participants in all experimental sessions. A Mann-Whitney test confirms that there are no significant differences between the best individuals and groups in each session. Furthermore, the number of observations in a single group session (5 groups) is too small for a statistical analysis, so an aggregation is necessary to draw meaningful conclusions.

sification. But from the second round on both samples perform on average significantly better than this benchmark according to a one sample t-test (t-value 3.66 for second round). So, on average, individuals as well as groups figure out very quickly how to beat the Sharpe ratio of an equally weighted asset allocation in our experiment.

4.2 Performance Comparison with Stochastic Groups

In this section we compare the quality of group decision-making relative to stochastic groups, which mimic potential group decision-making rules.[8] To this end from the data of our individual treatment we construct two types of stochastic groups and we compare the Sharpe ratios of those two stochastic group samples with our individual and group samples.

The first stochastic group sample, named "average stochastic group", mimics the behavior of groups, whose members agree to an even-handed compromise between the individual proposals for an asset allocation. In order to construct one observation in this sample, we randomly selected the asset allocation of three individuals per round from our sample of 45 individuals and we calculated the average of those three allocations. The second stochastic group sample, called "best-in-group stochastic group", reflects the behavior of groups, whose members select their best individual allocation decision in each round. To construct an observation in this second sample, in each round we choose the best individual allocation from a group of three randomly selected individuals, again from our sample of 45 individuals. This follows the idea of Lorge and Solomon (1955) about the truth-wins-standard, but in contrast to the original idea, our approach does not require the optimal solution but only the best individual solution across all group members.

[8] For an introduction into approaches that involve stochastic groups see Lorge, I., Fox, D., Davitz, J. and Brenner, M., 1958. A survey of studies contrasting the quality of group performance and individual performance. Psychological Bulleting, 55(6), 337-372..

In order to generate the data for our stochastic groups we randomly match individuals into groups of three people and keep these groups fixed over all rounds of the experiment.[9] Both samples of stochastic groups contain 1000 observations and we compare the Sharpe ratios of those two types of stochastic groups with the Sharpe ratios of the real groups in each round.

Figure 1a shows that the average stochastic group sample as well as the best-in-group stochastic sample outperforms our real groups in almost all rounds of the experiment. In contrast Figure 1b reveals that the median Sharpe ratio in the group sample performs similar to the median of the average stochastic group sample but below the best-in-group sample. This is evidence that large outliers in the experiments can be found more among the worst than the best groups and individuals. According to Mann-Whitney tests, the difference between the Sharpe ratios of average stochastic groups and our real groups is only significant in 2 out of 15 rounds. So we cannot reject the hypothesis that there is no difference between the performance of real and average stochastic groups. By contrast, the average Sharpe ratio of the best-in-group stochastic groups is significantly higher at the 5% level than the average Sharpe ratio of our 16 real groups in each but one round of the experiment. In short, real groups perform as well as the sample of average stochastic groups but clearly fail to reach the performance of best-in-group stochastic groups. Hence, the opportunity to discuss the asset allocation within the group does not seem to enhance the performance beyond a simple averaging of opinions. In particular, groups fail to select the best opinion among their members (the truth-wins-standard), let alone are they able to generate a solution that outperforms all individual

[9] There is one caveat in the method of constructing stochastic groups. The individuals that make up one observation in a stochastic group have received the feedback for their own personal asset allocation in each round of the experiment and not the feedback for the performance of the stochastic group. So it might be the case that individuals would have reacted differently had they received the stochastic group's feedback instead of the feedback for their own individual asset allocation. On the other hand it is unclear in which way individuals would have reacted. So a simple approach looks adequate to us because our stochastic groups only serve as a benchmark to judge the decision quality of individuals and groups.

solutions within the group. This is in contrast to the results by Lombardelli et al. (2005) who find that groups outperform the best individuals. However, our results so far have been obtained for the group sample as a whole. In Section 4.5 we will have a closer look at the decision-making process within the groups and we will see that some groups are indeed able to meet the truth-wins-standard.

In addition we observe that the sample of average stochastic groups realizes significantly higher Sharpe ratios than the individual sample in 9 out of 15 rounds at the 10% level and the average Z scores of all 15 rounds is -1.72.[10] This result is due to the fact that the average Sharpe ratio of 3 individual allocations is not equal to the Sharpe ratio of the average of 3 individual allocations. In our data about 70% of all observations the average Sharpe ratio of 3 individuals is below the Sharpe ratio of the average asset allocation of those 3 individuals. The reason is that averaging 3 individual allocations moderates extreme positions with very low Sharpe ratios in our sample. Such extreme allocations with low Sharpe ratios occur fewer times in the sample of average stochastic groups than in the sample of individuals. A comparison between median and average Sharpe ratios for the individual sample supports this observation, in particular in the first rounds of the experiment, where the average is lower than the median due to a few unsuccessful outliers among the individuals. Their impact is moderated if they are combined with other individuals as in the sample of average stochastic groups.

4.3 Portfolio Risk and Asset Allocation Shifts

We now focus on the degree of risk in group and individual portfolios. Figure 2 shows that the average portfolio volatility of groups is similar to the one for individuals in most rounds. Mann-Whitney tests indicate that there is no significant difference between the individuals' and groups' portfolio volatility at the 5% level in all but two

[10] The Sharpe ratio of the best-in-group stochastic group sample is significantly higher than the Sharpe ratio of the individual sample which is obvious by construction.

rounds of the experiment. The spike of the average group volatility in round 6 can be explained by two groups who both allocated a high percentage number to the most risky asset (A) in that round. So we cannot reject the hypothesis that there is no difference between individuals' and groups' preferences as far as portfolio risk is concerned. Figure 3 supports Figure 2 in that there are no material differences between the average weight assigned to the different assets by groups and individuals in each round. Compared to the optimal allocation, both, groups and individuals, start with an overweight in the riskiest asset (A), an underweight in the least risky asset (B) and quite a good allocation to the mid risky asset (C).

From the choice of an allocation we now move on to shifts in asset weights from one round to the next. The shift in any given round is defined as the sum of the absolute changes in percentage points allocated to each asset from the last round to the given round.[11] There is no material difference between the shifts in the individual and the group sample as Figure 4 points out. Groups' shifts are larger than shifts of individuals in all but two rounds but the effect is not significant in any round. Hence, we cannot reject the hypothesis that groups and individuals show the same degree of persistence in their asset allocations. On average both individuals and groups shifted roughly 50 percentage points in the first round and then almost linearly decreased this rate to roughly 10 percentage points in the last round (see Figure 4). We conclude this section by noting that groups do not choose less risky or more risky asset allocations than individuals and they show the same level of flexibility with respect to new allocations as individuals.

4.4 Comparison of the Performance Volatility of the Samples

So far we have only considered averages and medians in all of our samples. Now we focus on differences within the samples. To analyze the homogeneity of individuals and

[11] For example, an allocation of 30% in asset A, 30% in asset B and 40% in asset C in round 1 and 40% in A, 30% in B and 30% in C in round 2 yields a shift of 20% in round 2.

groups we compare the volatilities of the Sharpe ratios in the different samples in all rounds of the experiment. Figure 5 shows that for all samples the volatility decreases during the course of the whole experiment, indicating that the participants in each sample agree more and more about the optimal allocation in the experiment from one round to the next. We find no significant difference between the sample volatility of individuals and groups in a Mann-Whitney test. But, over the whole experiment, the volatility of true groups is significantly higher at the 5% level than the volatility of both types of stochastic groups. A high volatility in the Sharpe ratios reflects large discrepancies in the asset weightings across the subjects and we will address potential reasons for those discrepancies in the next section.

To analyze the discrepancies in the performance in more detail, we construct one comprehensive sample that consists of the average Sharpe ratios of all individuals, all true groups and all average stochastic groups. So this sample contains 1061 observations of average Sharpe ratios (1000 stochastic groups, 45 individuals and 16 true groups) over all 15 rounds of the experiment. We then split this comprehensive sample into deciles according to the average Sharpe ratio and we analyze the structure of each decile (Figure 6). In each decile there are always 106 Sharpe ratio observations (107 in the bottom decile), for example 96 observations from stochastic groups, 7 from individuals and 3 from true groups (top decile in Figure 6). Figure 6 shows how many individuals and how many true groups are located in each decile. It can be observed that the average Sharpe ratios over the whole experiment of most individuals as well as most groups are located either in the top two or in the bottom two deciles, which demonstrates the heterogeneity in our individual and true groups sample. Given the structuring approach of average stochastic groups, this is consistent with our previous arguments that an aggregation of individual allocations will lead to a moderation of extreme positions. 12 out of 16 true groups were located either in the top two deciles (5 groups) or the bottom two deciles (7 groups) and only 4 groups fell into the 6 deciles in the middle. The 7 groups in the lowest 2 deciles did not moderate extreme individual positions as much as our sample of average stochastic groups. This suggests the presence of a group polarization effect because the unsuccessful groups in our sample did not build asset allocations that led to Sharpe ratios in the middle of the sample distribution but made rather bad allocations compared to average stochastic groups.

A sensitivity analysis reveals that the occurrances of individuals and true groups in the total sample with 1061 observations from the first 5 rounds, the rounds 6-10 and the last 5 rounds does not change materially. For the first 5 rounds of the experiment also 12 groups are located in either the top two (4 groups) or the bottom two deciles (8 groups). For rounds 6-10 5 groups are in the top two deciles and 4 groups are in bottom tow deciles and for the rounds 11-15 5 groups are in the top two deciles and 5 groups in the bottom two deciles. It follows that the observation of large performance discrepancies across groups is stable over all 5-round periodes of the whole experiment. The same result applies for individuals.

4.5 Decision-Making Processes of the Groups

From the previous section we know that the volatility in the performance across groups is high, in particular in the first rounds of the experiment and that most groups either perform very well (top decile) or very badly (bottom decile). A potential reason is that the level of information exchange across group members is positively correlated with the performance of a group. The recordings of the group discussions reveal that the intensity and the frequency of the information exchange are very different across the groups in our sample. We measure the level of information exchange with four quantifiable factors which are listed in Table 2. The scores for each factor allow a crude assessment of the level of information exchange across group members. We only rely on recordings between the start of the experiment and round 9 because the differences in the Sharpe ratios from round 10 onwards are small.

The first factor is called “focus time” and represents the minutes each group is focusing on the experiment by discussing various issues about how to solve the asset allocation problem. Factor two is named “focus ratio” and reflects the ratio of focus time and spare time where spare time is defined as the time the group discusses other topics than the experiment. The reason to include this factor is that not every experimental session is equally long and this factor serves as a measure to judge a group’s focus on the experiment independently from the absolute level of focus time. The third factor “suggestions” measures how many suggestions each group brings up by counting every individual suggestion of every group member. A suggestion is defined as a statement of a group member about how much weight a certain asset should receive in the asset allocation. Factor four is named “arguments” and counts the number of arguments that are brought up by the group members during the discussion. An argument is defined as a statement that supports a group member’s suggestion in that it either points out an advantage or demonstrates its logic in order to convince the other group members about the suggestion.

We aggregate the scores for the four factors into a single measure called “information exchange score” (last column in Table 2). Every group that scores above the median in all four factors is categorized as a “high-information-exchange-group” (HIE-group). In total 6 groups are categorized as HIE groups. Groups that score below the median in all four factors are referred to as “low-information-exchange-groups” (LIE-group). We find 5 LIE-groups in our sample. 4 groups are not categorized because they perform above the median in some but not all four factors so we cannot judge if they belong to the HIE or the LIE group. One group is excluded because the recording is not available due to technical problems. Finally, we compare the Sharpe ratios of HIE-groups and LIE-groups for every round of the experiment and use Mann-Whitney tests to analyze the significance of the differences.[12]

Figure 7 shows that the Sharpe ratios of HIE-groups were larger than the Sharpe ratios for LIE-groups in every round of the experiment. The difference is significant according to Mann-Whitney tests at the 10% level in 10 rounds. HIE groups also beat individuals at the 10% significance level in 12 out of 15 rounds. Furthermore, HIE-groups significantly outperform average stochastic groups in 12 out of 15 rounds at the 10% level and marginally but not significantly beat the performance of the best-in-group stochastic groups in almost every round. In contrast the average Sharpe ratio for LIE-groups is even lower than for individuals in the first 6 rounds but not on a significant level except for 2 rounds. The sharp fall of the average Sharpe ratio in the LIE groups in round 5 is due to a 100% allocation in the riskfree asset of one group which has a strong negative impact. If we exclude this observation, the performance of LIE groups in Figure 7 becomes much smoother but the disappointing results of LIE groups do not change materially.

It is not surprising that the largest differences between HIE and LIE groups occur in the first rounds of the experiment because the information about the best performer in each round helps all participants to judge their performance round by round. While HIE groups identify efficient allocations pretty early in the experiment due the high information exchange, LIE groups need more time to evaluate their performance.

In a sensitivity analysis we structured the HIE and LIE groups slightly different by adding the four uncategorized groups to either HIE or LIE groups. The results do not change materially as the sample of HIE groups always outperforms the sample of LIE groups. We conclude that in line with the thinking of Stasser and Titus (1985) a high level of information exchange in a group leads to a significantly better performance.

[12] We acknowledge that the correlations across our four factors are high with a range from 0.557 to 0.923.

4.6 Decision-Making Time

From the section above we know that the factors “focus time” and “focus ratio” are positively correlated with a better performance within the sample of groups. A comparison of the time used to enter an asset allocation decision on the computer terminal between HIE-groups and LIE-groups reveals that HIE-groups use more time in every round of the experiment. A Mann-Whitney test confirms that the difference is significant at the 10% level in 10 rounds. Hence, it may be that groups who exchange more information perform better, because these groups take more time to analyze the allocation task in our experiment.

Individuals have no chance to exchange any information, so it is not surprising that they need much less time to enter their asset allocation. Figure 8 shows the average and the median decision time of individuals and groups per round. On average individuals use 51 seconds to decide whereas groups use 82 seconds per round. Mann-Whitney tests prove that the difference between groups and individuals is significant at the 5% level in 14 out of 15 rounds. The time used to define the allocation decreased for both groups and individuals during the experiment but the difference is stable.

4.7 Performance Beliefs of the Participants

Finally, we focus on the participants’ ex post beliefs about the performance of groups versus individuals in our experiment. After the completion of their experimental session in 45 out of 93 subjects expressed the view in questionnaire II that groups will achieve higher Sharpe ratios in the asset allocation task than individuals. Only 18 subjects believe that individuals will outperform groups. The remaining subjects express no opinion. The belief that groups outperform individuals is even more prevalent among group members, as 30 group members believe groups to outperform and only 4 group members express the view that individuals will outperform groups in the experiment. In the individual sample 15 individuals share that belief that groups outperform whereas 14 believe individuals to outperform. It seems as if the participants in the group experiment value the fact that they could solve the experiment as a group. But, as we have seen above, the achieved Sharpe ratios in the experiment only confirm the group member's impression in HIE-groups.

5. Discussion and Conclusion

Groups on average outperform individuals in an asset allocation task with intellective features but the difference is not significant. However, an analysis of the group sample average disregards the heterogeneity of the groups' performances. Our analysis shows that groups with a high level of information exchange perform as well as best-in-group stochastic groups, which by construction select the best individual allocation of 3 randomly chosen individuals. Therefore, these high information exchange groups meet a special version of the truth-wins-standard. On the other hand, groups with a low level of information exchange underperform all other samples and the difference is significant in the first rounds of the experiment. Our results support the existing literature by providing evidence that the decision-making process – in our case addressed via the information exchange level – significantly influences the success of groups. In line with the thesis of Janis (1982) this paper shows that successful groups evaluate available information and ideas of all group members before choosing an asset allocation. In contrast, unsuccessful groups typically opt for the first suggestion by a group member and therefore do not make use of the possibility to pool their personal opinions. This is consistent with the group polarization effect described by Moscovici and Zavalloni (1969). It seems that the absence of an information exchange within the group does not moderate individual opinions, i.e. asset weightings in the asset allocation, but rather produces extreme asset allocations. So groups, who do not carefully discuss potential solutions but agree to the first suggestion of one group member, might implement more extreme asset weightings than the one obtained by averaging the opinion of all group members. Our results are also in line with the hidden profile effect discussed by Stasser and Titus (1985), as our experiment demonstrates that a lack of information exchange is related to an underperformance of groups. It is beyond the scope of this paper to analyze reasons for the differences across the information exchange level in the groups in depth. Further research is needed to figure out how certain factors influence the group members' willingness to exchange information.

After the experiment a clear majority of all participants share the view that groups outperform individuals. It might be the case that people simply prefer to take decisions in a group regardless of the decision-making process and the achieved results. However, more research is needed to analyze the confidence of individuals to better solve problems in a group.

In reality many funds organize the fund management in groups. While further research is needed to analyze people's preferences in the domain of financial decision-making in general, our experiment shows that groups do not add value per se. Only if the group members' opinions are communicated and discussed, do groups outperform individuals. Therefore, whenever group decisions need to be taken it is important to create an environment which motivates people to exchange information. However, our results also show that while groups have the potential to outperform individuals, they also incur larger costs as more persons take more time for their decision making than one individual. Hence, from the point of view of an employer it is not clear whether it is more efficient to employ a group or one individual to solve a particular task.

An interesting extension of our experiment would be to introduce a judgmental element by letting the participants trade the assets they use for the asset allocation task during the experiment. In such a task the participants have to take into account the behavior of other participants in order to find the optimal solution for the asset allocation problem. Such an interaction of the participants reflects reality much better because the prices and the returns of assets on financial markets are not stable as in our experiment but heavily depend on the investors' supply and demand situation. Adding an interactive element to our experimental design might give more insight into the decision-making process, the rationality, and the potential success of individuals and groups on financial markets.

Figures and Tables

Table 1

Table 1a lists the different assets (A, B, C and D) in the experiment and their returns in the 4 different states of nature . Every participant only received Table 1a.

Table 1b contains the excess returns of each asset above the riskfree rate, the covariance matrix resulting from the state-returns in Table 1a and the weights of each asset in the tangency portfolio as well as the resulting maximum Sharpe ratio achievable in every round. Only the relative weightings of the risky assets A, B and C are relevant for the calculation of the maximum Sharpe ratio. For example and allocation of 3% in A, 33.5% in B, 13.5% in C and 50% in D respectively would have also returned the maximum Sharpe ratio.

Table 1a					
State	**Probability**	**Return Asset A**	**Return Asset B**	**Return Asset C**	**Return Asset D**
I	0.25	15%	4%	0%	1%
II	0.25	-2%	5%	5%	1%
III	0.25	8%	1%	9%	1%
IV	0.25	-4%	0%	-1%	1%

Table 1b				
	Asset A	**Asset B**	**Asset C**	**Asset D**
Excess Return	3.25%	1.5%	2.25%	0%
Covariance Matrix	Asset A	Asset B	Asset C	
Asset A	0.0059	0.0004	0.0003	
Asset B	0.0004	0.0004	0.0000	
Asset C	0.0003	0.0000	0.0016	
Tangency portfolio (weights)	6%	67%	27%	0%
Sharpe ratio of the tangency portfolio: 0.923				

Table 2

The table shows the groups' scores for all four factors (Focus Time, Focus Ratio, Suggestions and Arguments) as well as the spare time used to calculate the factor "focus ratio". The scores and the aggregated Information Exchange Scores are listed for each group except for group 5, because the discussion recording of this group is not available due to a technical problem.

Table 2						
Group	**Focus Time in Minutes**	**Spare Time in Minutes**	**Focus Ratio (Focustime/ Sparetime)**	**Number of Suggestions**	**Number of Arguments**	**Information Exchange Score**
1	12	16	0.8	15	5	low
2	27	1	27.0	39	26	high
3	12	16	0.8	24	6	low
4	28	0	28.0	47	28	high
5	–	–	–	–	–	–
6	22	0	22.0	32	13	medium
7	16	6	2.7	33	15	medium
8	20	3	6.7	38	21	high
9	15	7	2.1	16	5	low
10	17	5	3.4	24	15	low
11	20	2	10.0	58	33	high
12	19	3	6.3	40	28	medium
13	23	0	23.0	43	34	high
14	16	7	2.3	27	13	low
15	19	4	4.8	32	13	medium
16	21	2	10.5	48	19	high

Figure 1

Figure 1a shows the average Sharpe ratio per round for individuals, groups and both stochastic groups; average stochastic groups and best-in-group stochastic groups.

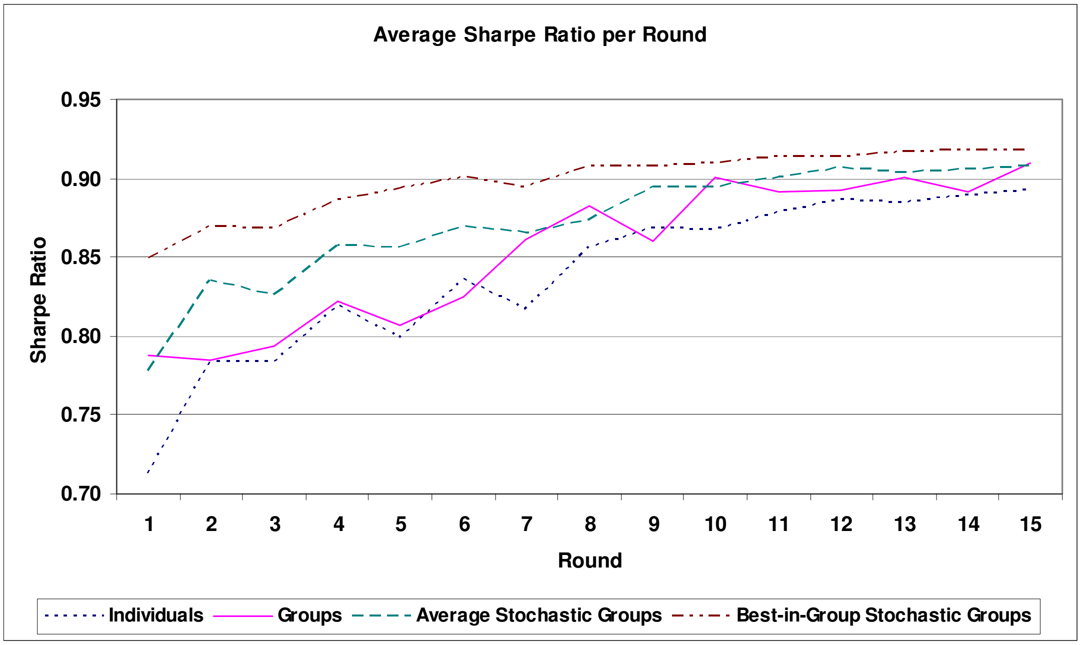


Figure 1b shows the median Sharpe ratio per round for individuals, groups and both stochastic groups; average stochastic groups and best-in-group stochastic groups.

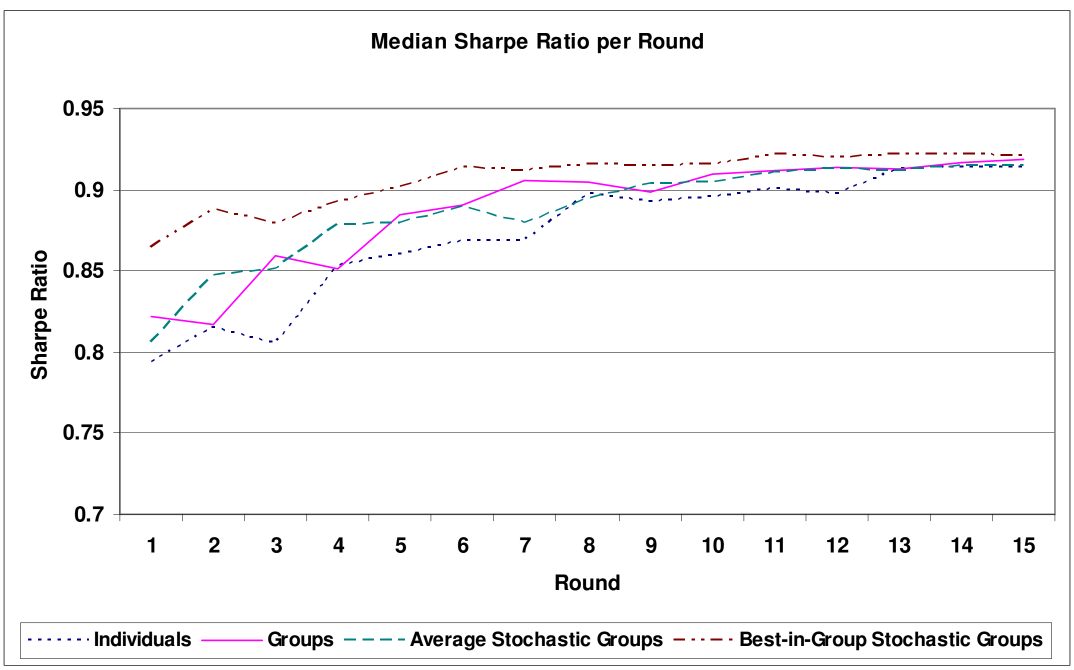


Figure 2

The figure shows the average portfolio volatility of individuals, groups and both types of stochastic groups per round.

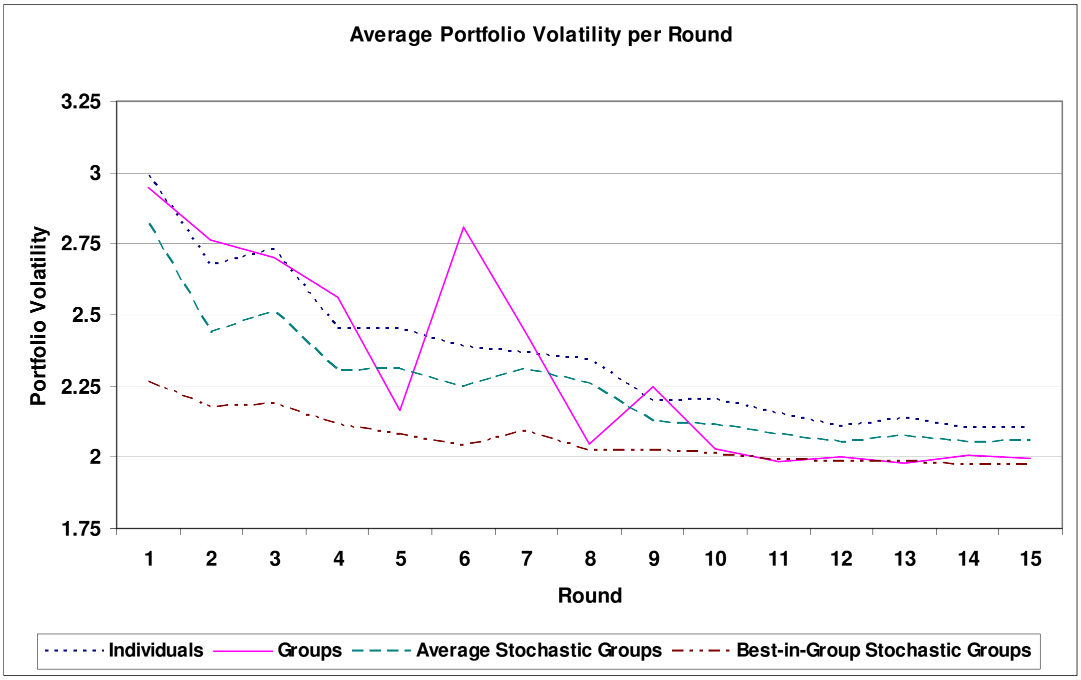


Figure 3

The figure shows the average allocation of groups and individuals to the 3 risky assets (A, B and C) in each round of the experiment. The allocations in Figure 3 have been normalized in order to make them comparable because the allocation to the riskfree asset (D) does not influence the Sharpe ratio. So the allocations to the 3 risky assets have been inflated to a total of 100% while keeping the relative weighting of all 3 risky assets. GA, GB, GC stands for the groups' average allocation and IA, IB, IC for the individuals' average allocation in assets A, B and C.

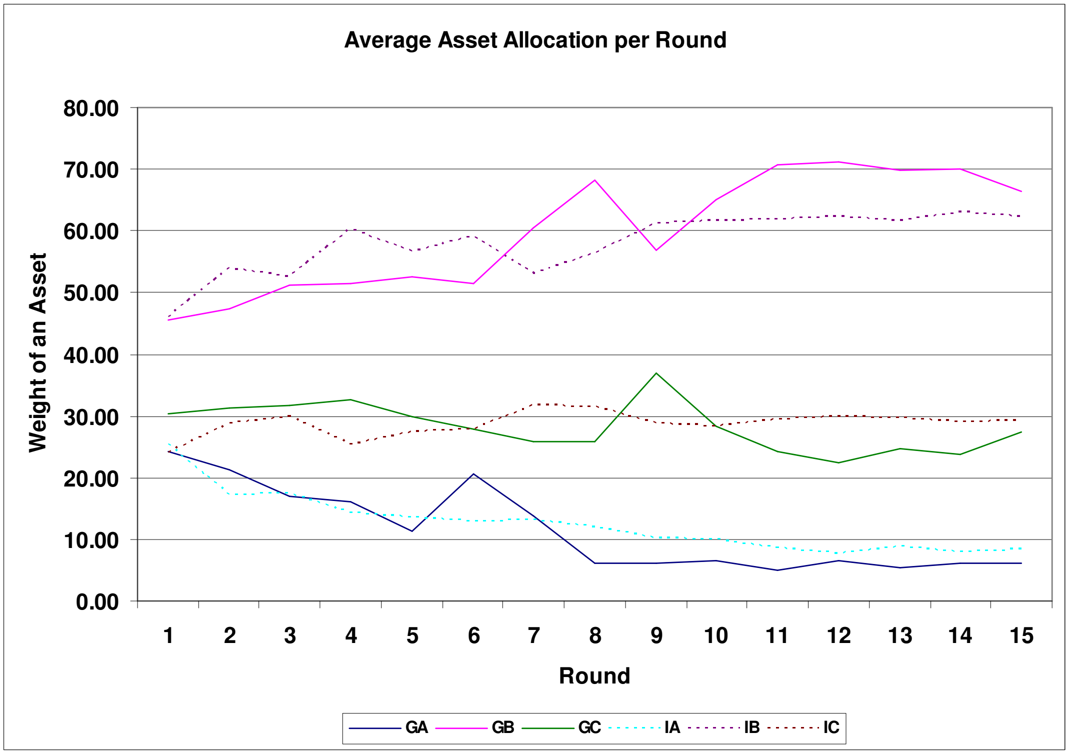


Figure 4

The figure shows the average shift in the asset allocation per round for individuals, groups and both types of stochastic groups. Here, the shift in any given round is defined as the sum of the absolute changes in percentage points allocated to each asset from the last round to the given round.

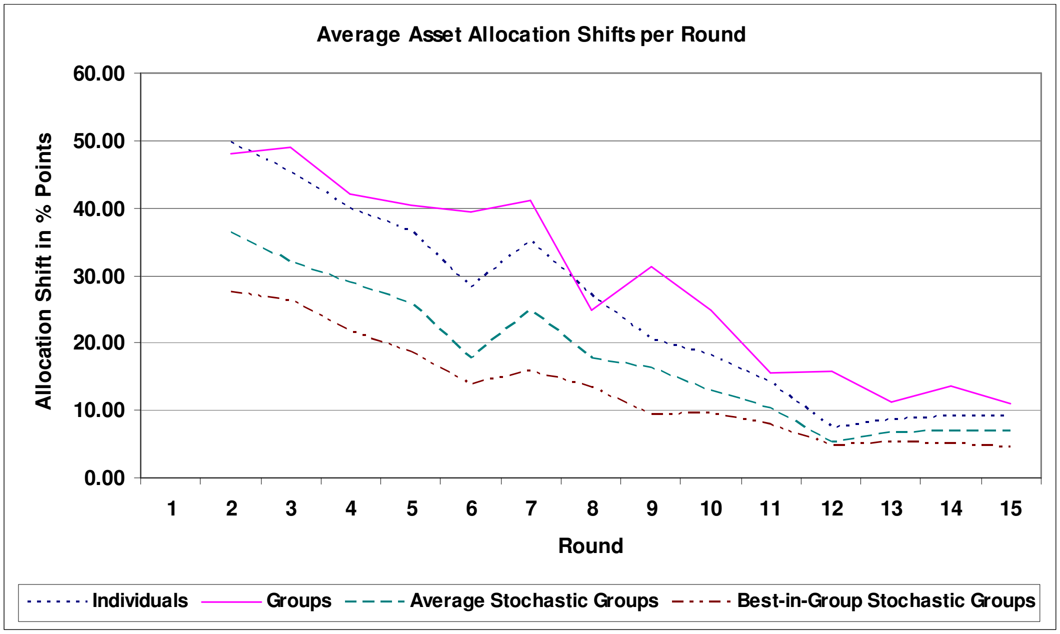


Figure 5

The figure shows the volatilities of the Sharpe ratios in the individual, the group and both of the stochastic group samples.

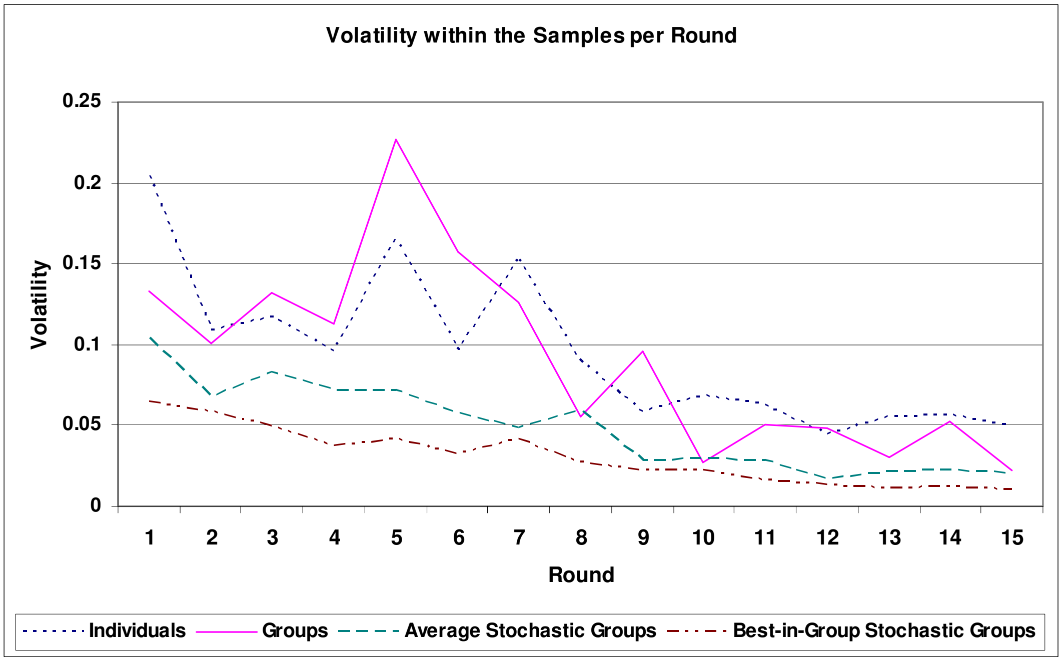


Figure 6a

In the sample of individuals, true groups and stochastic groups together there are 1061 Sharpe ratio observations. In each decile there are 106 observations and in the bottom decile there are 107. The deciles are determined according to the Sharpe ratio for the aggregate samples of the individuals, true groups and average stochastic groups. The figure shows the number of true groups and individuals in each decile from the top to the bottom average Sharpe ratios.

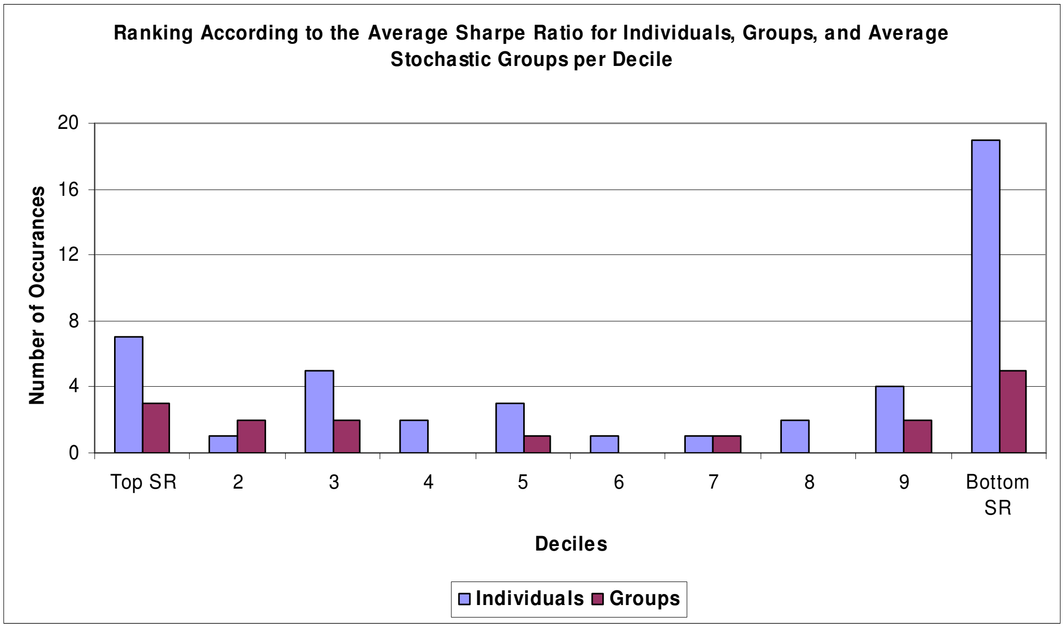


Figure 7

The figure shows the average Sharpe ratios of individuals, high-information-exchange groups (HIE-groups), low-information-exchange groups (LIE-groups), average stochastic groups and best-in-group stochastic groups for every round in the experiment.

The sharp fall of the average Sharpe ratio in the LIE groups in round 5 is due to a 100% allocation in the riskfree asset by one group which has a strong negative impact. The curve for the LIE groups would be much smoother if we excluded this particular group in round 5.

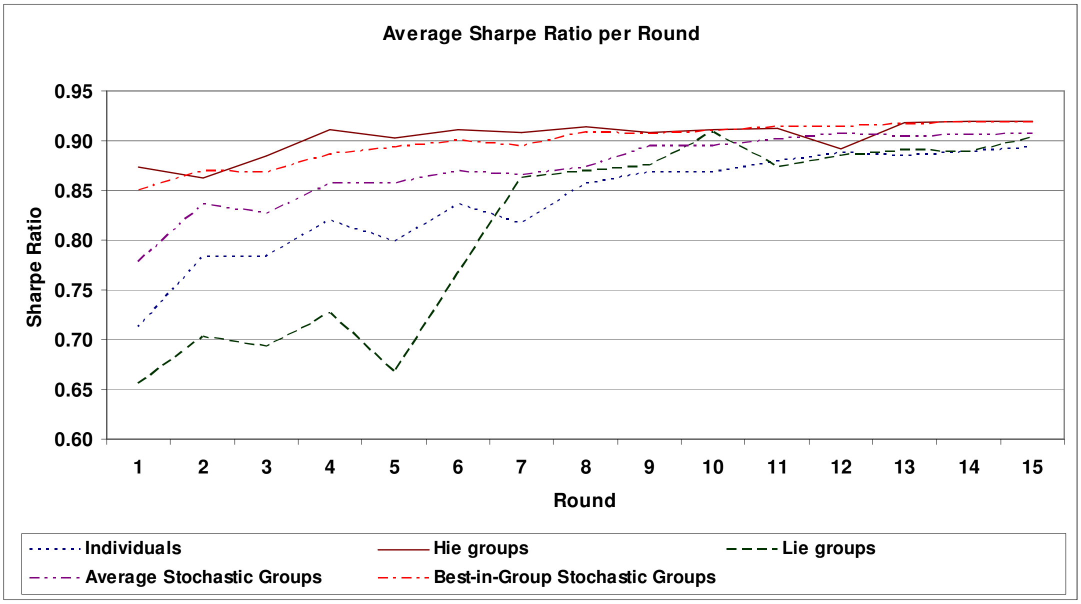
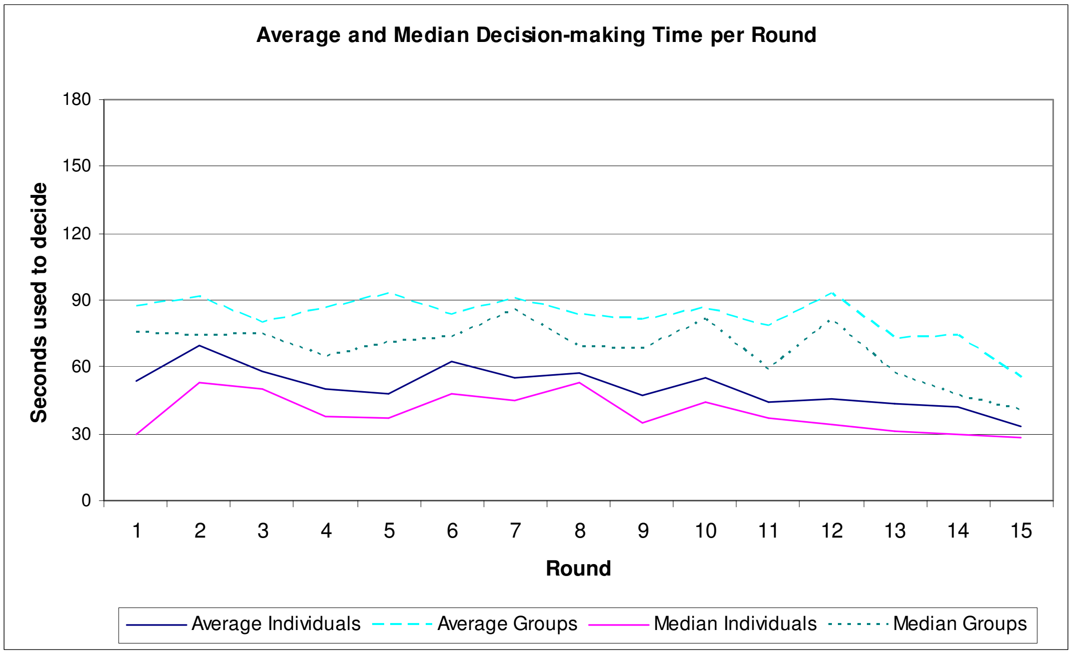


Figure 8

The figure shows the average and the median time used to decide about the allocation for groups and for individuals per round.



Appendix I

The instructions provided in this section are translated from the original German instructions.

Instructions to the experiment

Welcome to our experiment! In this experiment you will be asked to take several decisions on a computer terminal. Your payoff depends on your decisions and on the decisions of the other participants. So please read the following instructions carefully.

In the experiment certain technical expressions are used that might not be familiar to you. Those expressions will be introduced on the next pages of this instruction. In case you have any questions please raise your hand and one of the instructors will come to your place and answer your questions.

The participants in this experiment are students with different backgrounds from the University of Zurich and from the ETHZ. All participants receive exactly the same information like you. All participants can keep and use the instructions during the whole experiment.

The experiment starts as soon as every participant has fully understood the course of the experiment and has correctly completed the questionnaire I.

Please respect that communication with the other participants is not allowed during the experiment. Mobile phones must be switched off. Please operate only those functions on the computer which are needed in the course of the experiment. Communication with other participants or bugger with the computer leads to an exclusion of the experiment.

In case you have any question the instructors are ready to help.

Goal of the Experiment

The goal of the experiment is for all participants to combine 4 different assets (3 risky assets A, B, C and 1 riskfree asset D) in such a way to achieve as much return as possible with as small risk as possible over all rounds of the experiment. The experiment consists of 15 equal rounds in which all participants can change the allocation across the 4 different assets in order to increase their risk-return-ratio.

All relevant technical expressions of the experiment will be explained in the next section.

Explanations

Asset: An asset is an investment that increases (or decreases) in value. For a riskfree asset (like for example a bank account) the appreciation of the value is fixed. For a risky asset like, for example, a stock the appreciation, respectively depreciation, is variable.

Return: The return is defined as the increase or decrease in the value of an asset expressed in percentage points. An asset with a return of 5% increases its value by 5% and an asset with a return of -1% reduces its value by 1%.

Scenarios: The return of an asset in the experiment depends on the realization of 4 different scenarios (I, II, III or IV). The probability of a scenario is identical (i.e. 25%) for all scenarios. The following table provides an overview about the returns of the different assets A, B, C and D in the different scenarios.

The table is at your disposal on the computer screen during the whole experiment.

Scenario	Probability	Return Asset A	Return Asset B	Return Asset C	Return Asset D
I	0.25	15%	4%	0%	1%
II	0.25	-2%	5%	5%	1%
III	0.25	8%	1%	9%	1%
IV	0.25	-4%	0%	-1%	1%

Example 1: In scenario I asset A returns 15%, asset B returns 4%, asset C returns 0% and asset D returns 1%.

Example 2: In Scenario II a combination of 50% in asset A, 50% in asset B and nothing in assets C and D returns 1.5% (0.5 * (-2)% + 0.5 * 5% = 1.5%).

Mean Return: The mean return is the average return that is achieved with an asset or a combination of assets over all scenarios.

Example 3: The mean return of asset B is

0.25 * 4% + 0.25 * 5% + 0.25 * 1% + 0.25 * 0% = 2.5%

Example 4: The mean return of a combination of assets with a weight of 50% in B, 50% in D and nothing in A and C is

0.25 * (0.5 * 4% + 0.5 * 1%) + 0.25 * (0.5 * 5% + 0.5 * 1%) +
0.25 * (0.5 * 1% + 0.5 * 1%) + 0.25 * (0.5 * 0% + 0.5 * 1%) = 1.75%

Excess return: The mean return of an asset or a combination of assets minus the risk-free return of the asset D yields the excess return:

Excess return = Mean return of an asset – Riskfree return

Example 5: The excess return of asset B is 2.5% - 1% = 1.5%.

Example 6: The excess return of a combination of assets with a weight of 50% in B, 50% in D and nothing in A and C is 1.75% - 1% = 0.75%.

Risk: Risk is defined as the variability of the returns of an asset or a combination of assets in different scenarios. The larger the variability is the higher is the risk. The risk is calculated by taking the square root of the sum of the squared differences between scenario returns and the mean return of an asset. When we call the scenario returns of an asset R_I, R_{II}, R_{III}, R_{IV} in the different scenarios and M the mean return of this asset then the formula for the risk is:

$$Risk = \sqrt{0.25(R_1 - M)^2 + 0.25(R_2 - M)^2 + 0.25(R_3 - M)^2 + 0.25(R_4 - M)^2}$$

Example 7: If we assume, $R_I = R_{II}$=5% and $R_{III}=R_{IV}$=10%. Then the mean return is

M=0.25 * 5% + 0.25 * 5% + 0.25 * 10% + 0.25 * 10%= 7.5% and the risk is

$$Risk = \sqrt{0.25(5\%-7.5\%)^2 + 0.25(5\%-7.5\%)^2 + 0.25(10\%-7.5\%)^2 + 0.25(10\%-7.5\%)^2}$$

Risk-return-ratio: The risk-return-ratio is defined as the ratio between the excess return of an asset and the risk of an asset or a combination of assets:

Risk-return-ratio = Excess return / Risk

The risk-return-ratio increases if the excess return increases or if the risk decreases.

Special case: If the risk is 0 then the risk-return-ratio is also 0.

Example 8: An asset with a mean return of 5% and a risk of 8% offers a risk-return-ratio of (5% - 1%) / 8% = 0.5.

Payoffs

Your payoff is linked to your performance in the experiment. The relevant measure is the risk-return-ratio. Based on your achieved risk-return-ratio in each round the mean risk-return-ratio for the whole experiment is calculated. During the experiment you always see the level of your average risk-return-ratio across all rounds played so far.

Your average risk-return-ratio will be multiplied with 30. This will yield the payoff in CHF that you receive at the end of the experiment.

The participant with the highest average risk-return-ratio receives an additional bonus of 20 CHF. For the participants ranked 2., 3., and 4. with respect to the risk-return-ratio a bonus of 10 CHF will be paid. In addition to the performance based payoff every participant receives a show-up bonus of 10 CHF.

The payoffs are paid immediately after the experiment by the instructors.

Description of the Experiment

The experiment consists of 15 rounds and one trial round.

Before the trial round questionnaire I must be correctly completed. Hand in your questionnaire I to the instructors as soon as you have completed it.

Every participant has to choose in each round how he wants to weight the 4 different assets A, B, C and D to achieve the highest possible risk-return-ratio. Every participant can allocate 0% up to 100% to each asset (enter the weight without decimal places into the computer). The sum of all asset weights must add up to 100%.

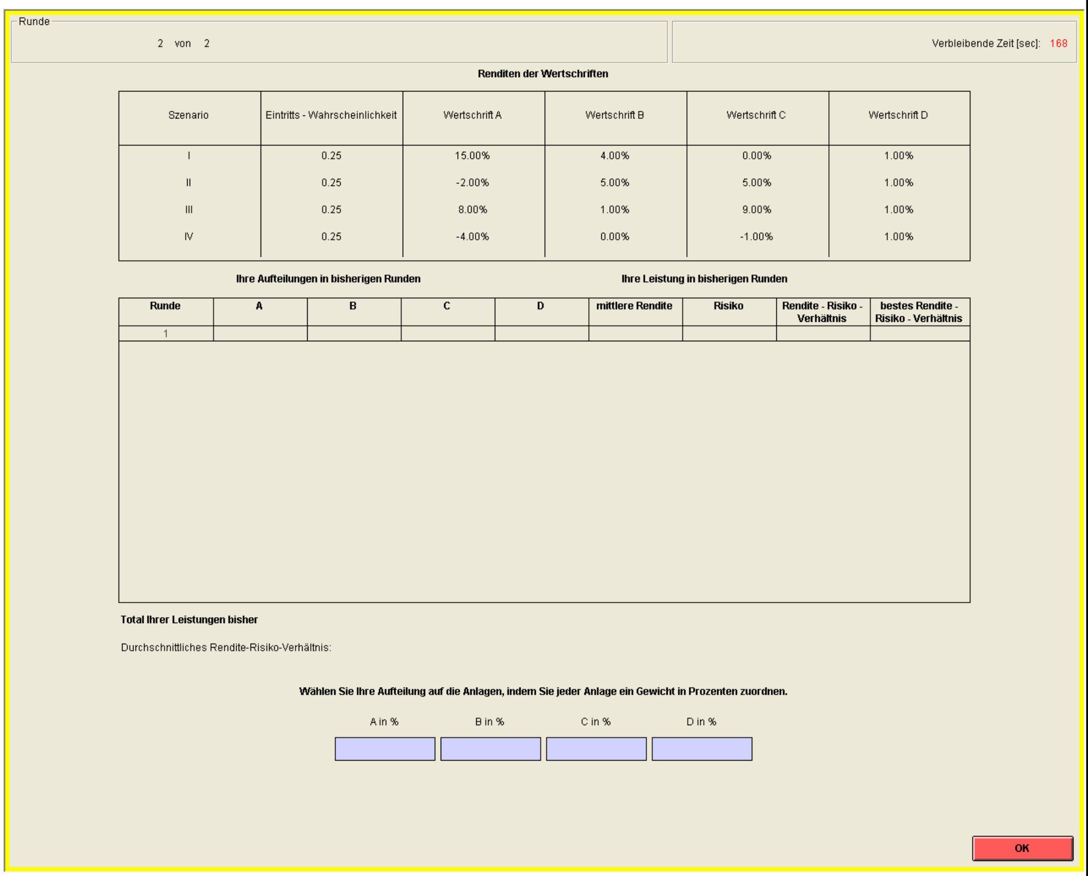
As soon as all participants have entered their combination of assets the computer will calculate the mean return, the risk and the risk-return-ratio of each participant. Every participant will be informed about his own numbers on the computer screen. In addition every participant gets informed about the highest risk-return-ratio that was achieved by a participant in the round. With this a round is completed. At the beginning of the next round each participant can chose a new weight for each of the 4 assets. This process will be repeated until 15 rounds have been played.

Course of the experiment

Please show your answers to an instructor as soon as you have completed questionnaire I. The trial round starts as soon as every participant correctly answered all questions in questionnaire I.

Trial round

In the trial round you can make yourself familiar with the computer and the different actions you need to take during the experiment. You see the following screen. Top left shows the round that is currently played and top right shows you how much time you have left to enter your asset weights.



The upper table shows the return of each asset A, B, C, D in the different scenarios of the experiment.

The table in the middle shows your weightings of each asset in the previous rounds and the corresponding return, risk and risk-return-ratio you have achieved with your allocation. It also shows the highest risk-return-ratio of a participant in a round of the experiment. Each completed round will be listed in this table.

Your overall performance is the basis for your payoff at the end of the experiment. The average risk-return-ratio is the relevant measure and it is shown below the middle table of the screen.

In each round you see 4 small boxes on the bottom of the screen. Please enter the weightings of each asset for the next round in those boxes. Check your weights and make sure that they add up to 100%. Then please confirm by clicking ok. You have 3 minutes to enter your asset allocation in each round. If you have not entered an allocation for each asset within 3 minutes, 100% will be booked into the riskfree asset D.

As soon as all participants completed the trial round the experiment starts with round 1.

Rounds

The course of each round is similar to the trial round and the screens also look identical. As soon as all the participants enter their asset allocation you will receive the information about your performance in the round.

End of the experiment

After round 15 the experiment is over. The instructors will inform you accordingly and hand out the payoffs.

Appendix II

The questionnaires provided in this section are translated from the original German questionnaires. It is important to note that technical expressions like return, risk or volatility have been introduced and defined in the instructions (see appendix I). In addition every participant had the chance to ask questions before completing the questionnaire I.

Questionnaire I – Questions before the start of the experiment

1. In 4 scenarios a certain combination of assets A, B, C and D yielded the following returns:

   3% -1% 6% 4%

   What is the mean return of this combination of assets?

3%	5%	6%	1%
O	O	O	O

2. What is the excess return of this combination of assets if we assume a riskfree rate of 1%?

4%	3%	2%	0%
O	O	O	O

3. Which of the following two assets is riskier?

Asset X with the following returns in the 4 scenarios of the experiment	Asset Y with the following returns in the 4 scenarios of the experiment
12%, -6%, 9% and -1%	3%, 0%, 2% and -1%
O	O

4. Which of the two combinations of assets offers the higher risk-return-ratio?

Combination X with an excess return of 5 % and a risk of 10%	Combination Y with an excess return of 4% and a risk 4%
O	O

5. What is the payoff of a participant if he achieved an average risk-return-ratio of 0.5 in the experiment (without any bonus and without the show up fee)?

20 CHF	15 CHF	12 CHF	10 CHF
O	O	O	O

6. Did you understand the goal and the rules of the experiment?

   O Yes   O No

Questionnaire II – Questions after the experiment

1. Age:........................

2. Gender: O Female O Male

3. What do you study?

Natural Science (ETHZ)	Anything but natural science (ETHZ)	Economics (UniZH)	Anything but economics (UniZH)
O	O	O	O

4. Who do you think will achieve higher risk-return-ratios in the experiment, groups or individuals?

Groups	Individuals	Similar	Equal
O	O	O	O

5. Would you have preferred to participate as an individual (as a group member) in the experiment?

   O Yes O No O Does not matter

6. How do you judge your risk-return-ratio relative to the other participants in the experiment?

Very low	Low	Rather low	Average	Rather high	High	Very high
O	O	O	O	O	O	O

7. How did the risk-return-ratio of your asset allocations evolve during the experiment?

Definitely increased	Increased	Rather increased	Constant	Rather decreased	Decreased	Definitely decreased
O	O	O	O	O	O	O

8. Do you have a private securities account?

   O Yes O No

9. How often do you read financial news or financial articles?

Daily	Almost daily	Weekly	Monthly	Quarterly	Yearly	Never
O	O	O	O	O	O	O

10. How would you judge your interest in financial topics?

Very low	Low	Rather low	Average	Rather high	High	Very high
O	O	O	O	O	O	O

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