

Funds of Hedge Funds and Behavioral Finance

A Survey on the Selection and Monitoring of Hedge Funds

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October 2003

Abstract:

The selection and monitoring of hedge fund managers require competence and skills beyond a simple risk-return analysis. In particular, fund of hedge fund experts are required to select and interpret the relevance of a large amount of descriptive information in order to evaluate the skills of hedge fund managers. The study shows that professionals perform these tasks using simple heuristics. Thereby they tend to develop a biased perception of randomness and change their preferences in context dependency. Overall, the returns of funds of hedge funds in the sample are not dependant on one particular decision criteria but rather on the amount of information their manager rank as very important. However, there are seldom more than few decision criteria that determine above-average returns.

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INTRODUCTION

The hedge fund industry and its clients

Hedge funds represent one of the fastest-growing sectors of asset management. Originally exclusively serving the needs of very high net worth individuals, hedge funds have gradually opened to private and institutional investors. The more individuals became eligible to invest in these vehicles, the more vigorous was the discussion on the hedge funds business and their contribution to traditional portfolios. Hedge funds usually claim to be capable of offering high absolute returns without additional risks, as well as low correlation with returns from traditional investments. Investors, in general, seem to be attracted by the potentially equity-like returns with bond-like volatility offered by hedge fund strategies. However, the growing variety of investment styles in conjunction with a broad range of leverage and hedging strategies employed by hedge funds require an expertise that is far beyond a simple risk-return analysis.

The additional risks and challenges posted by hedge funds present a serious impediment for investors interested in this investment vehicle. The complexity of the evaluation process and the experience necessary to perform an effective monitoring process often discourage investors to invest in hedge funds directly. Investors with time constraints, little experience, or limited capital often prefer investing in a fund of hedge funds.

Investing in fund of hedge funds

The evaluation of fund of hedge funds (FoF) managers is likely to be as difficult as the assessment of hedge fund managers themselves. The major difficulty stems from the low entry barriers in the fund of hedge funds business (Lhabitant, 2003). Since meanwhile almost every bank, insurance company or investment management firm provides fund of hedge funds products, the recognition of investment talents in the fund of hedge fund arena becomes more challenging.

In general, the funds of hedge funds business includes five crucial tasks: classification of various hedge fund strategies, construction of a portfolio of investment styles expected to meet certain objectives, selection of appropriate managers consistently following these investment styles, ongoing monitoring, and rigorous risk management. Investment style evaluation, portfolio construction, and risk management issues have been already discussed in many research papers. In contrast, the criteria for selection and monitoring of hedge funds remained outside the attention of the research society particularly due to the fact, that most of the qualitative decision criteria inherent for these decision processes are still not well-matched with the broadly used framework of optimization and return analysis. Consequently, the relative importance of selection and monitoring issues discussed by regulatory authorities or other professionals can differ substantially across fund of hedge fund managers and have a different impact on their performance.

Purpose of the study

If the main concern of investors is on absolute performance, the evaluation of the investment decision process should depend essentially on its contribution to it. In this sense, applying decision criteria, which are not in consensus with the concept of rationality, can be also considered as optimal as long as they contribute to the achievement of stated performance

goals. In this context, the various coherence criteria stemming from the laws of logic and probabilities can be replaced with judgment criteria that relate decision-making strategies to external performance goals rather than to internal consistency.

This way of reasoning is crucial for the purpose of this study, which is twofold. First, it analyzes if the selection and monitoring processes of fund of hedge funds are affected by decision rules deviating from the concept of rationality. Second, the study investigates the question whether relatively weighted decision criteria applied by FoF managers are related to the returns they achieve. In other words, the study tests the conjecture, if applying decision rules inconsistent with the concept of rationality can be considered as optimal in terms of return objectives.

This study does not claim to provide a list of common rules for hedge funds selection and monitoring. It is rather a contribution to the discussion initiated by Kahneman and Tversky on the 'positive' and 'negative' messages associated with their 'heuristics and biases program' in relation to some extensions made within the 'fast and frugal heuristics program' of Gigerenzer, Todd, and the ABC Research Group.

PREVIOUS RESEARCH

Fund of hedge funds

In contrast to traditional investments, hedge funds have variable return sources that make its valuation much more difficult. This valuation complexity is expected to be overcome by fund of hedge fund professionals implementing rigorous quantitative analysis on the characteristics of different hedge fund strategies. The quantitative analysis includes how they are expected to perform in the existing (or expected) market environment, and how a combination of hedge fund strategies can contribute to higher diversification, respectively to lower portfolio risk (Sharpe, 1999). All these issues have been debated intensively in the literature.¹ In contrast, the efficiency of criteria applied by the selection and monitoring of hedge funds is discussed only in few contributions. A general analysis on the fund of hedge funds business with a comment on some key aspects of generating a strong value proposition is provided by Ineichen (2002), Lhabitant (2003), and by the Alternative Investment Management Association (2002).

So far, fund of hedge funds investing has been mainly discussed as an alternative to individual hedge funds. Fund of hedge funds provide investors with professional management, due diligence services and access to otherwise closed hedge funds. One should expect that investors are ready to pay for these services, but the additional returns would compensate them for any fee charged. Unfortunately this is not the case. Empirical studies by Amin and Kat (2002) and Liang (2003) show that the double fee structure of fund of hedge funds is a significant drawback for their performance. Brown, Goetzmann, and Liang (2003) confirm these results and propose a new fee arrangement based on the idea that fund of hedge fund managers can hedge the incentive fees of individual hedge funds and provide an aggregate fee on fund of hedge funds level. In this case, investors are not going to end up paying incentive fees to individual hedge

¹ Hedge fund strategies represent a very heterogeneous group. They can be defined by particular *style* of investment. Existing methods for defining hedge fund styles focus on return-based style factors. Fung and Hsieh (1997) use the idea that managers having the same style will generate correlated returns. They apply factor analysis on hedge fund returns to extract style factors. Agarwal and Naik (2000) relax the constraints of conventional style analysis and examine the significance of positive and negative style weights. Siegmann and Lucas (2002) develop an optimization model based on loss aversion generating four different pay-off patterns consistent with various patterns in dynamic investment strategy returns. The optimal number of hedge funds and the influence of *diversification* on the various characteristics of the return distribution are analyzed by Lhabitant and Learned (2002).

funds when the fund of hedge funds is losing money. Since investors can gain exposure to hedge funds through passively managed fund of hedge funds (or index hedge funds) for lower costs, the question why should investors pay double incentive fees becomes more relevant.

Decision-making biases and the experts

There is an increasing list of phenomena, especially based on experimental evidence, describing individual decision-making processes that are inconsistent with fundamental axioms of the finance theory.² Since time and cognitive resources are limited, individuals cannot analyze all the data the environment provides. Instead, they use rules-of-thumbs (or '*heuristics*') to select the relevant information and make a decision. In certain circumstances, heuristic principles are a useful shortcut. Example of such a useful short is to find a strategy in chess to reduce the enormous space of possible moves at each point in a game. Though, so far heuristics were mainly invoked as explanations for individuals' reasoning incompatible with the concept of rationality.

Even experts, (or those who have been recognized within their profession to have the necessary skills and abilities to perform at the highest level), do not seem to be immune to cognitive biases associated with the use of heuristics. Kahneman (1991) stated a widely held conclusion: 'There is much evidence that experts are not immune to the cognition illusions that affect other people'. Stephan and Kiell (1999) confirmed that highly professional foreign exchange traders make use of some judgmental heuristics as well. A quite different view of experts emerged from the research in cognitive psychology. Studies within this field have shown that experts are skilled, competent, and think in qualitative different ways than novices (Shanteau, 1992a). Additionally, expert judgment often lack the complexity expected from superior decision maker, either in the number of significant decision criteria or in the model used to describe their judgment. In particular, Shanteau (1992b) shows that experts differ from novices in the way they select and interpret relevant information. The author provides evidence suggesting that novices may rely on too much information and that experts are better because they are more selective. In other words, it is not the use of multiple information sources that makes a decision-maker an expert but the way he/she makes use of it. Simple decision rules or heuristics may lead to accurate and useful inferences as suggested by the 'fast and frugal heuristics' program of Gigerenzer, Todd, and the ABC Research Group.

METHODOLOGY

Choice of methodology

The prevalent approach to identify the expertise of professional investment managers is performance-oriented, i.e. it focuses on the final results of a complex set of investment decisions. In contrast, most of the experimental studies on decision making strategies are more concerned with the influence of specific decision task characteristics. In these studies, an outcome-oriented approach is mainly used for the evaluation of tasks requiring a *judgment* as an estimation of particular value. In finance, this approach is suitable for studies that analyze for example the accuracy of forecasts made by financial analysts or other professionals. Conversely, if the task requires a *choice* between several alternatives, the preferred evaluation

² Heisler (1994), De Bondt and Thaler (1994), Hirshleifer (2001), and Barberis and Thaler (2002) provide selective overviews on the literature with particular relevance for finance.

approach in experimental studies is process-oriented (Rieskamp and Hoffrage, 1999).

Although this study is not designed as an experiment, the idea of considering the characteristics of decision tasks while choosing among alternative research methods is worth considering. In the case of selection of hedge funds, professional investors have to decide which manager(s) has (have) the best skills within a particular investment style. Since this decision requires a comparison between different candidates by applying a certain set of decision criteria, the process-oriented approach appears more suitable than the output-oriented method.

The purpose of the study restricts the choice of implementation methods significantly. To develop statistical information on the decision behavior of professionals, FoF managers from different companies have been invited to participate in an online-questionnaire. This methodology has some significant disadvantages. First, there is a certain amount of uncertainty concerning the gap between provided answers and the real behavior of survey's participants. Second, there are no monetary incentives (or punishments) that can motivate participants to provide correct answers. To limit the impact of these issues, most of the participants have been contacted personally. They received information on the purpose of the study, in particular about its very aim to learn more about the investment decision rules they apply and not to question their competence.

Issues of interest

The process of managing a fund of hedge funds is complex and not fully standardized. It usually involves filtering the universe of several thousand hedge funds, quantitative analysis, due diligence as well as ongoing monitoring. After completing the top-down investment process, which defines the asset allocation in terms of hedge fund strategies, the FoF management has to select the best hedge fund managers within every investment style. In contrast to the top-down investment process, the practice of selecting hedge fund managers with superior skills is based on decisions that require filtering and interpretation of large amount of descriptive information. To achieve a decision consistent with the classical concept of rationality, managers have to form estimates on probabilities of uncertain events, attach payoffs to each of their outcomes and choose the correct alternative. They must be relentless in their forward-looking perspective and be able to leave past decisions behind. These tasks are particularly challenging for decision-makers dealing with descriptive information simply because of the uncertainty concerning the "right" translation of available information into payoff structures with corresponding probability measures.

Structure of the survey

The survey is divided in four parts. The first one contains some background information such as the age of the fund, its assets under management, and number of investment products. The second part attends the process of selecting individual hedge funds with investment skills. The main goal of this section is to detect the existence of particular decision patterns and to analyze their consistency and statistical significance. The discussion involves the 'hot hands' effect (Gilovich, Vallone, and Tversky, 1985 a) and the 'conjunction fallacy' (Kahneman and Tversky, 1982). These effects show how managers' decisions depend on their abilities to distinguish between randomness and skills, how they assess the relationship between skills and subsequent performance, and how they deal with probabilities. Additionally, this part of the survey examines the role of managers' personal experience and feelings in the context of a systematical decision procedure employed on company level.

The third part of the survey analyzes monitoring issues. It compares the relative importance of various decision criteria for the replacement of hedge fund managers and analyzes some aspects of the context dependence of preferences.

The last part of the survey aims to evaluate the relative importance of various investment decisions criteria, which have been studied in the previous parts of the survey and considered as relevant in the literature discussing investing in hedge funds. This section tests the hypothesis that differences in the relative importance of decision criteria across FoF manager can explain differences in the performance of their investment products. It also analyzes if the *amount* of information considered as important is also relevant for achieving superior returns.

RESULTS

Sample description

The online questionnaire was sent to 82 funds of hedge funds companies managing multi-strategy investment products. 9 of them responded immediately and another 13 companies with main offices in Switzerland were contacted personally. The questions were answered by professionals who are responsible for the selection and monitoring of hedge funds. The assets under their management vary between EUR 50 Mio and EUR 30 Bill. The average fund of funds included in this survey has 7 products under management and the manager 8.9 years of experience.

Selection of hedge funds

The main objective of the individual hedge fund manager selection process is the detection of investment skills. Since the abilities of a hedge fund manager are not observable, FoF investors are constrained to a set of inferences, which help them to make conclusions about the abilities of hedge fund managers to provide superior performance in the future. This information can be transmitted through a signal (or indirectly through a contract). Actions are adequate signals if their costs are sufficient high so that the “bad” agents won’t carry them out and sufficiently low so that the “good” agents will (Macho-Stadler and Pérez-Castillo, 2001). For example, the experience of hedge fund managers is often considered to be a signal of their abilities to manage investment decisions in different market environments. Another example is the hurdle rate hedge fund managers choose. The higher the hurdle rate is, the better the investment strategy has to be. Otherwise hedge funds remain charging a considerable lower management fee, than the performance fee they would charge if they reach the settled hurdle rate.³ In contrast to the manager’s experience and the choice of a hurdle rate, an outstanding past performance record becomes an informative signal only if the probability of occurrence due to the influence of external factors such as chance is considered to be sufficient low.

In experimental studies, people’s intuitive perception of chance departs systematically from the law of randomness. They expect to see the essential characteristics of a chance process not only globally in the entire sequence, but also locally, in each of its parts. This perception of chance in samples regarded as representative for the entire population has been described as the ‘*belief in the small numbers*’ (Tversky and Kahneman, 1971).

People’s perception of randomness in sequences has some real implications. Gilovich, Vallone,

³ The median management fee of hedge funds is 1%, the median incentive fee is 20% (Agarwal, Daniel, and Naik, 2003).

and Tversky (1985) compared people's beliefs concerning the sequential characteristics of hits and misses in basketball with the facts. They show that basketball fans believe that player's chance of hitting the basket following a hit is greater than following a miss. The actual performance did not support these beliefs. In other words, the sense of having '*hot hand*' does not predict hits or misses. Camerer (1989) and Brown and Sauer (1993) confirmed their results.

Individual investors seem to have the same erroneous perception of a positive correlation between successive shots. Empirical findings suggest that flows into and out of mutual funds are strongly related to lagged measures of their excess returns (Sirri and Tufano, 1998). Similar results have been reported for hedge funds by Agarwal, Daniel, and Naik (2003). They found that good performer in the previous year experience larger money flows compared to other funds. Their findings are consistent with a modeling approach suggested by Berk and Green (2002), which explains the relationship between fund flows and performance, using the assumption that investors infer managers' skills from past performance. In other words, the authors assume that investors believe in the existence of hedge fund managers with '*hot hands*'.

To test the accuracy of this prevalent conjecture, FoF managers were asked to choose between two hedge fund managers A and B, which appear equally skilled according to the set of selection criteria applied but manager B shows a better track record over the same time period. Three possible answers have been suggested. Respondents can choose between hedge fund manager A and B or be indifferent between both. Clearly, if respondents believe that past performance record is determined by skills, then they should be indifferent between both managers since both hedge fund managers are equally skilled according to the selection criteria applied. The results are presented in Figure 1. The hypothesis that the average FoF manager does not choose the hedge fund manager with the better track record can be rejected at the 95% level of confidence ($p = 0.017$).⁴

Question:
 Consider two hedge fund managers A and B. Both appear equally skilled according to your set of selection criteria, though B has a better track record over the same period.
 Which one would you choose?

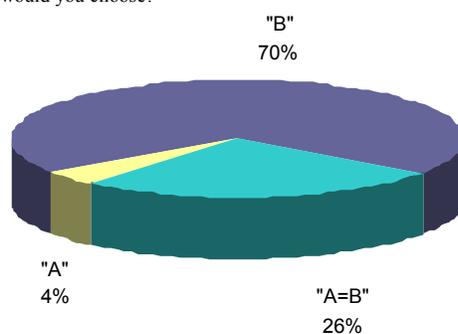


Figure 1: The '*hot hands*' effect

The results suggest that under the assumption, that the selection criteria FoF companies apply are designed to detect the investment skills of individual hedge fund managers, the majority of survey's participants consider past performance record as an information signal, to be related to

⁴ This conclusion results from a binomial test. The null hypothesis is that there is no difference between the probability of choosing manager B (or A) and to be indifferent between both of them. For a two-tailed test with $N=23$, $k=6$, the probability associated with the occurrence under the null hypothesis is 0.017. Inasmuch as this probability is smaller than $\alpha=0.05$, the decision is to reject the null hypothesis.

other factors in addition to the investment skills of the hedge fund managers. Since the impact of these factors is uncertain, it can be considered as random and the average respondent is ready to bet on it. From this perspective it is surprising that, when asked to estimate the correlation between the past performance of a hedge fund manager and the future prospects of his/her investment strategy, the majority of FoF managers decide to follow the recommendations of the investment products' disclaimer stating that past performance is not guarantee for future performance and estimates this relationship as medium (see Figure 2). From this perspective, decisions to set on past performance realizations unrelated to some managers' skills can be interpreted as conscious bets.

Question:

How strong do you estimate the relationship between past performance of a hedge fund manager and the future prospects of his/her investment strategy?

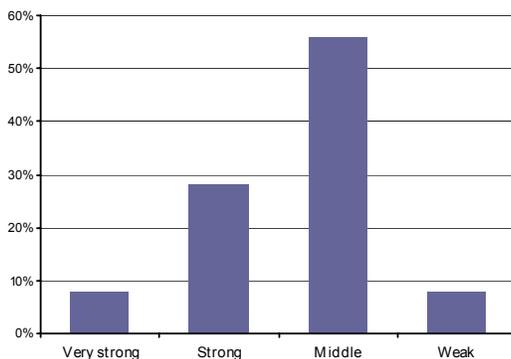


Figure 2: Estimated correlation between the past and future performance of hedge fund managers

The next question analyzes if and how FoF managers change their opinion about a hedge fund manager when they receive information for the reasons of manager A's inferior performance. As Table 1 shows, 59% of all FoF managers have previously decided to choose manager B but would change their opinion, if manager A provides explanation for his/her inferior performance. Only 13.6% of all FoF managers were indifferent between the managers in the first case and do not change their judgment. The fact that 73% of the respondents change their opinion suggests that FoF managers consider the availability of plausible explanations for the outcomes of investment strategies more reliable than a set of strict decision criteria. The hedge fund manager who shows understanding of where his/her performance comes from is perceived as more competent as his/her opponent who had a better track record. Manager A can not only make up for his/her inferior track record but also gain some additional votes (9.1%) from FoF managers who were previously indifferent.

Question:

Would you change your opinion if manager A provides plausible explanation for his inferior performance record?

Previous choice	Yes	No
"Manager A"	4.5%	
"Manager B"	59.1%	13.6%
"Indifferent between A and B"	9.1%	13.6%
Total	72.7%	27.3%

Table 1: Changes in opinion after receiving explanations for inferior performance

Since the majority of FoF managers seem to perceive the track record as containing more information than from an analysis of investment skills, how do FoF managers use this information. The results are presented in Figure 3. The majority (64%) of the respondents prefer to consider track record characteristics by the evaluation of potential diversification effects rather than for a choice between hedge fund managers with particular investment style characteristics. This result is consistent with the conclusion that a track record, which is perceived to be driven by supplementary factors unrelated to skills, is more useful for quantitative portfolio analysis rather than in the hedge funds' selection process.

Question:

Which hedge fund manager would you prefer if all other manager's characteristics are equal?

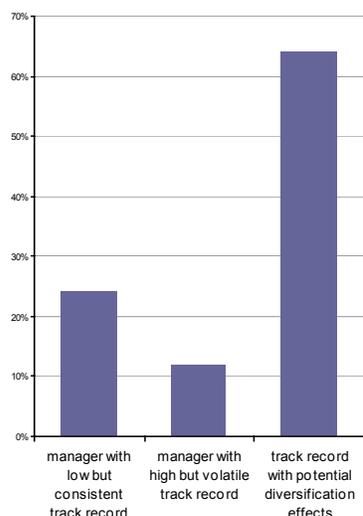


Figure 3: Track record characteristics as criterion for choosing hedge funds

The previous results suggest that the respondents' preferences change in dependence of the context. In a situation involving past and future performance issues, the average FoF manager would not rely on the past performance as a selection criterion, since he/she does not believe on strong correlated returns over time (Figure 2). However, in the context of a decision requiring consideration of investment skills, FoF managers change their preferences: the past performance record of hedge fund managers, although presented in the question as unrelated to investment skills, gains in importance and dominates a skilled-based investment decision (Figure 1). The idea that this decision is a conscious bet does not find sufficient support in the question about the overall relevance of track record. As Table 2 shows, 62% of the FoF managers who decide to bet on the superior track record of manager B in the previous question consider the track record as an information signal that helps to judge the diversification potential of a hedge fund strategy rather than the consistency of manager's performance. If FoF managers use the track record of hedge fund managers to determine the diversification potential of their strategies, it is not clear why they prefer managers with superior track record, which is unrelated to skills.

Previous choice	Preference for low but consistent track record	Preference for high but volatile track record	Track record as input for diversification analysis
"Manager B"	19%	19%	62%

Table 2: Consistence of preferences concerning the track record of hedge fund managers

Further tests on the consistency of respondents' decisions proceeds with the introduction of a different information signal, i.e. the hurdle rate a hedge fund manager chooses. Since the choice of a relative high hurdle rate compared to the peer group is costly⁵, one would expect that only hedge fund managers with relatively high confidence in the future prospects of their investment strategy would decide to signal them this way. The FoF community represented in this study is spitted.⁶ The one half shares the confidence signaled by the hedge fund managers, the other half does not. Though, when FoF managers are required to decide between two equally skilled hedge fund managers with different hurdle rates, the majority are indifferent between both hedge fund managers (see Figure 4).

Question:
 Consider two hedge fund manager A and B. Both appear equally skilled according to your set of selection criteria, though B has a higher hurdle rate. Which one would you choose?

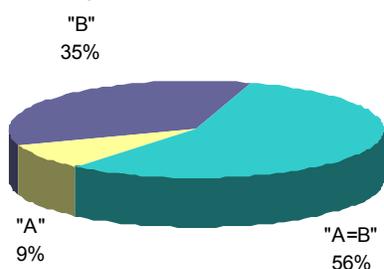


Figure 4: Differentiating hedge fund managers on the basis of hurdle rates

This question is very similar to the question testing the 'hot hands' effect. The only one difference is in the information signal that the FoF managers are required to evaluate. The consideration that hurdle rates are chosen by the hedge fund managers is important in this context, since the choice is not influenced by chance. This might be one of the reasons why the results differ from the previous. Another explanation is based on the idea that evaluation from a cross-sectional perspective is possibly easier. In contrast, assessing sequential realizations is more challenging. In such a problem setting, the belief of sequential dependency can easily dominate over the perception of the real sources for the observed realizations.

To complete the discussion on the evaluation of investment skills, FoF managers were asked to estimate the relationship between hedge fund managers' investment skills and their subsequent investment performance. While the majority of FoF manager assess the correlation between past performance and future prospects of hedge fund investments as medium, they assess the link between managers' skills and future return as strong (see Figure 5). In the context of the previous findings, this result has some interesting implications.

⁵ The higher is the hurdle rate, the higher is the return a hedge fund manager has to achieve before the investors pay for his/her performance.

⁶ 48% of the respondents consider the hurdle rates hedge fund manager choose as informative signal, 52% does not..

Question:

How strong do you assess the relationship between individual hedge fund manager's skills detected with the selection criteria you apply and his/her subsequent investment performance?

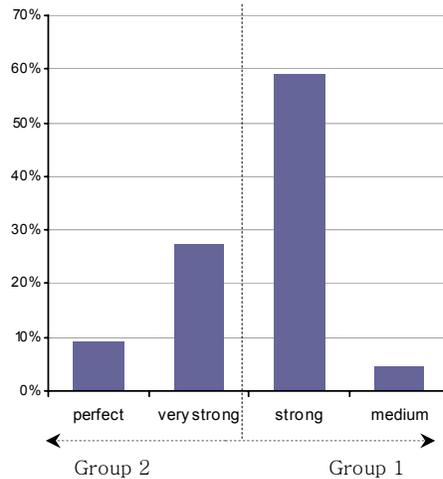


Figure 5: Estimated correlation between hedge fund manager's skills and subsequent investment performance

So far, the study developed some insights on how FoF managers deal with different information signals while assessing the hedge fund managers investment skills, and how they estimate the relationship between investment skills, past and future performance of hedge fund managers. As discussed previously, if performance is a deterministic function of skills, then deviations caused by other variables should occur randomly. Moreover, the assessed relationship between skills and performance should be the same in different contexts. If FoF managers are consistent in their decision behavior, they should assess the influence of random variables in the forward-looking decision problem in the same way as in backward-looking problem. In other words, FoF managers who prefer to invest in the strategy of hedge fund manager B should estimate the relationship between the hedge fund managers' investment skills and future performance as medium to strong (group 1 in Figure 5). Respectively, FoF managers who are indifferent between equally skilled hedge fund managers should assess the relationship between investment skills and future performance as very strong to perfect (group 2 in Figure 5).

The consistency of FoF managers' behavior is tested by measuring the significance of differences in voting decisions in both situations as suggested by Siegel and Castellan (2001). Each individual serves as its own control since he/she has to make two different decisions. A non-parametrical statistical test for two measures from one sample is applied instead of a t -test, which assumes that the realizations are independent and drawn from a normal distribution. The null hypothesis is: Among FoF managers with consistent behavior as defined above, the probability that group 1 behave consistently is equal to the probability that group 2 has consistent behavior as well. According to the test results⁷, the null hypothesis of consistent behavior is rejected at the 90%-confidence level.

FoF managers were asked to decide in which situations they would eventually use personal experience (or feelings) in forming a judgment on the of hedge fund managers investment skills. The available evidence in the literature suggests that reliance on feeling is particularly likely (1) under conditions in which one's feelings are a highly relevant source of information, and (2)

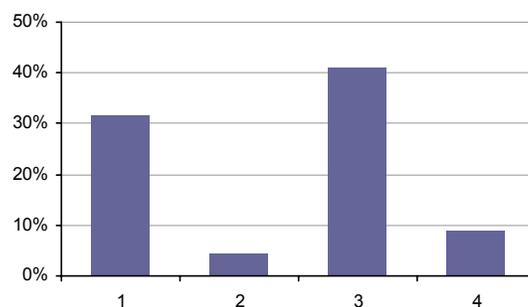
⁷ See Appendix A for calculations.

under conditions in which one's feelings allow for the simplification of a difficult task (Schwarz, 2002). There would be no investment gurus in financial markets if personal feelings are a redundant asset. On the other hand, attending to information provided by feelings is often perceived as interfering with what otherwise is a rational behavior. Moreover, feelings-based choice is criticized to be insufficiently sensitive to quantitative details and to be significantly affected by familiarity (Frederick, 2002). From this perspective, it is interesting to test if and when professionals decide intuitively in the role of a financial intermediary.

In the fund of hedge fund business, managers can rely on detailed information about a hedge fund manager and his/her strategy or simplify the evaluation task by using preexisting knowledge that worked well in the past. To analyze how this decision depend on the characteristics of the situation, FoF managers were asked to decide in what kind of situations they would consider their personal experience (or feeling) while assessing hedge fund manager's skills. Two main situations are of interest. The first one presents a situation when the settled selection criteria do not provide a clear signal allowing a decision and the FoF manager has a strong feeling (confidence) in one of the hedge fund managers. As expected, 32% of the survey participants feel familiar with this situation (see Figure 6).

Question:

In which situation would you eventually consider your personal experience (or feelings) while assessing managers' skills?



- 1: When the settled selection criteria do not provide a clear signal for your decision but you have a strong feeling (confidence) in one of the managers
- 2. When the settled selection criteria are not in favor of a particular manager but you have a strong positive feeling
- 3. When the settled selection criteria are in favor of a particular manager but you have a strong negative feeling
- 4. Never

Figure 6: The importance of personal experience or feelings

The second situation requires a decision based on two contradicting signals: one is based on the selection criteria, and the second is based on a personal feeling. Interestingly, the distribution of the corresponding answers 2 and 3 is not symmetrical. In the case of a conflict between selection criteria and personal feelings, FoF managers decide to trust their feelings if they are not in favor of the hedge fund managers. Only one manager would trust his/her positive feelings if the selection criteria do not provide a positive signal. The results suggest that on average negative signals based on feelings receive higher decision weights than negative signals based on settled judgment criteria.⁸ This is consistent with the conjecture that in controversial situations, personal feelings are applied to reduce potential losses rather than to bet on an

⁸ The null hypothesis that the probability of observing contradicting signals do not differ with respect to their characteristics as a feeling or selection criterion is rejected at the 95%-confidence level.

upside potential. In contrast, in situations with no conflict between different decision criteria, managers are more likely to resort to the ‘How-do-I-feel-about-it?’ decision. In general, the reliance on an effective impression (what do mean by effective impression) may be more accurate than analytic assessments of the features of the problem as some experimental results suggest.⁹

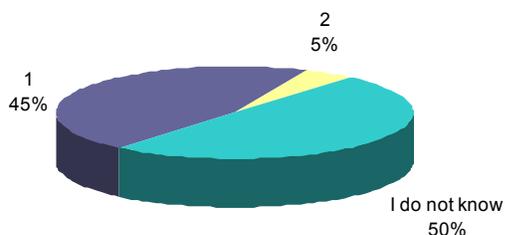
The last question in this section aims to test how professionals deal with probability concepts. The simplest and most fundamental qualitative law of probability is the extension rule: if the extension of A includes the extension of B then $P(A) \geq P(B)$. The same principle is represented by the *conjunction rule*: $P(A \& B) \leq P(B)$, i.e. the conjunction cannot be more probable than one of its constituents.

Experimental evidence by Tversky and Kahneman (1983) suggest that judgments under uncertainty are influenced by intuitive heuristics that are not bound by the conjunction rule. One of their testing procedures requires respondents to estimate the outcomes of a tournament in the context of intermediate results. The setting is very similar to a market where hedge fund managers compete to achieve certain performance benchmarks under the surveillance of investors monitoring their preliminary performance. To test the hypothesis that professionals are better in dealing with probabilities than novices in experiments, FoF managers are required to choose one of two alternatives, which they think is more probable. The first one is a situation (A), in which a hedge fund manager reaches his benchmark at the end of the year. The second alternative (B) is a situation in which the same manager does not reach his benchmark after a quarter but at the end of the year.¹⁰

According to the law of probability, the first alternative is more likely than the second one. As Figure 7 shows, 45% of the respondents share this view, 50% cannot decide between the alternatives. Thus, among the respondents having an opinion, the null hypothesis that the probability of choosing A is equal to the probability of choosing B can be rejected at the 98%-confidence level. In other words, if FoF managers decide they do it without violating the conjunction rule.

Question:

Assume that the investment strategy of hedge fund manager is expected to show results after a quarter. Which situation do you consider as more probable?



- 1: The hedge fund manager reaches his benchmark at the end of the first year
- 2: The hedge fund manager does not reach his benchmark in the first quarter but at the end of the year

Figure 7: The conjunction fallacy

⁹ Frederick (2002) points out that when people think about the reasons they like or dislike something they may focus on features that seem to be plausible determinants of liking rather than the features of another process.

¹⁰ The questions are a simplified version of the test used by Tversky and Kahneman. In their study, people are asked to rank four different outcomes from most to less likely: (A) Borg will win the match”, (B) Borg will lose the first set, (C) Borg will lose the first set but win the match, (D) Borg will win the first set but lose the match. 72% of the respondents violate the conjunction rule and assigned a higher probability to C than to B.

To summarize, this section of the study analyzed the relevance of several decision patterns for the selection processes applied by professional FoF managers. In particular, the section provided empirical evidence for a biased perception of randomness, context dependant preferences in past-looking and forward-looking problems but also on a proper use of the law of probability. Additionally, the section provided results describing the relevance of feelings in controversial situations.

The next section attends the process of monitoring of hedge funds and tests some of the implications of the Prospect Theory by Kahneman and Tversky.

Monitoring of hedge funds

The quality of a hedge fund product does not remain constant over the time. . Once the investment based on a successful initial due diligence process is made, professional FoF managers are required to conduct effective quality controls consisting of a large amount of important issues such as team and strategy changes, service provider or auditors substitution etc.¹¹ From a theoretical point of view, there are barely recommendations concerning the monitoring process beside of risk management issues. In contrast, experiments conducted in the heuristics-and-biases field suggest that mental shortcuts associated with previously made decisions prevent individuals from behaving optimally in the current situation.

This section of the study does not have the resources to perform the same tests as experimental papers do in order to proof differences between professionals and novices judgments in the context of previously made decisions. Instead, this section investigates, when FoF managers decide to replace a hedge fund manager with deteriorating performance and how FoF managers deal with a conflict generated by hedge funds providing superior performance on the costs of controllability.

To investigate these issues, FoF managers are required to consider different situations and to weight their relevance for a decision of replacing a hedge fund manager who was previously considered as potentially successful. First, FoF managers are confronted with a situation in which a selected hedge fund manager experiences several small performance deteriorations relative to the peer group or to the expectations of the FoF investors. The answers distribution to this situation are compared to the answers provided in a similar situation where the selected hedge fund manager shows a one-time but significant performance deterioration relative to his/her peer group. The main idea behind this question is based on a discussion by Tversky and Kahneman (1991) on effects of a reference-based choice.¹² One of the conclusions they make is that individuals habituate to steady states and adapt them eventually as new reference levels. If a FoF manager gets accustomed to small losses, which are by no means unexceptional, he/she would shifts his/her reference point every time accordingly. Since the marginal value of losses is expected to decrease with their size, the utility loss associated with a one-time large performance decline measured on the initial reference point, is smaller than the sum of small

¹¹ For examples of monitoring questions see Wisard (2003).

¹² According to the Prospect Theory developed by Kahneman and Tvesky the outcomes of risky prospects are evaluated by a value function with three essential characteristics. Reference dependence: value is generated by gains and losses defined relative to a reference point. Loss aversion: the function is steeper in the negative than in the positive domain, losses appear larger than corresponding gains. Diminishing sensitivity: the marginal value of gains and losses decreases with their size.

performance drops.¹³ Thus, a FoF manager should prefer to replace a hedge fund manager with several small performance deteriorations than a hedge fund manager experiencing a one-time large performance decline.

To evaluate whether FoF managers behave according to this conjecture, the responses are summarized in two histograms (see Figure 8). The answers distributions appear to differ in their mean and standard deviation. The majority of the respondents perceive small performance deteriorations relative to the peer group as more relevant consideration for a replacement of the hedge fund manager than a one-time performance drop. The statistical significance of this result is tested using a binomial test. The answers in both situations are split in two categories ('important' and 'not important'). If the importance of the first criteria is perceived to be the same as the relevance of the second one (in other words, the observed differences in the distribution are not statistically significant), then the probability of the same opinion (respectively opinion changes) should be the same in both cases. This hypothesis cannot be rejected at the 90% significance level ($p = 0.133$). Thus, the observed differences are not statistically significant.

Question:

Which factor(s) do you consider as decisive for a replacement of a hedge fund manager who was previously considered potentially successful?
Please indicate the relative importance

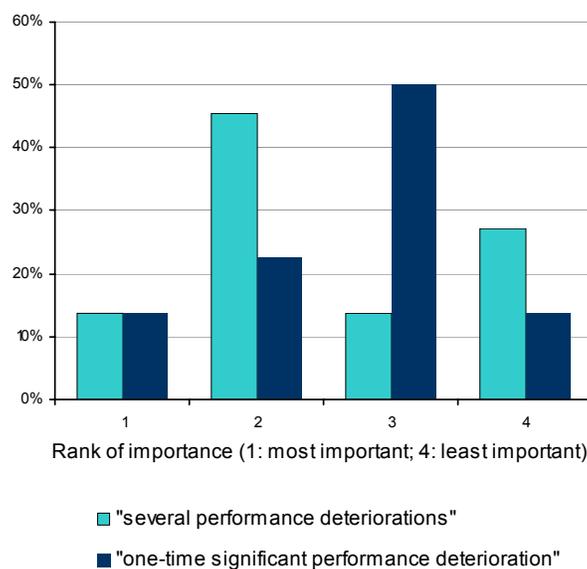


Figure 8: Importance of performance deteriorations for the replacement of hedge fund managers

The second part of the section on monitoring of hedge funds studies the respondents' decision behavior in a situation of conflict. FoF managers are required to decide, if they would replace a successful manager if they face unexpected shifts in his/her investment strategy, respectively non-cooperation with the FoF reporting process. As Figure 9 shows, the conflict situation seems not to lead to confusion among the FoF managers. On the contrary, the respondents are even more confident in their decision on how to trade off one attribute relative to the other as both distributions suggest. Hedge fund managers providing significant performance improvement

¹³ See appendix B for a graphical representation of this argument.

cannot compensate for unexpected shifts in their investments strategy. In contrast, a considerable part of the FoF managers (23%) is ready to excuse non-cooperation with their reporting process if the hedge fund manager provides a good performance. Though the null hypothesis, that a significant part of the respondents considering this as an important replacement criterion, is rejected at the 99% confidence level ($p = 0.008$). This result (though statistically insignificant) is surprising since non-cooperation with the reporting process implies, that some FoF managers do not receive all information required. Though, some respondents appear to have difficulties to abandon a current good performer.

Question:

Which factor(s) do you consider as decisive for a replacement of a hedge fund manager who was previously considered potentially successful?
Please indicate the relative importance

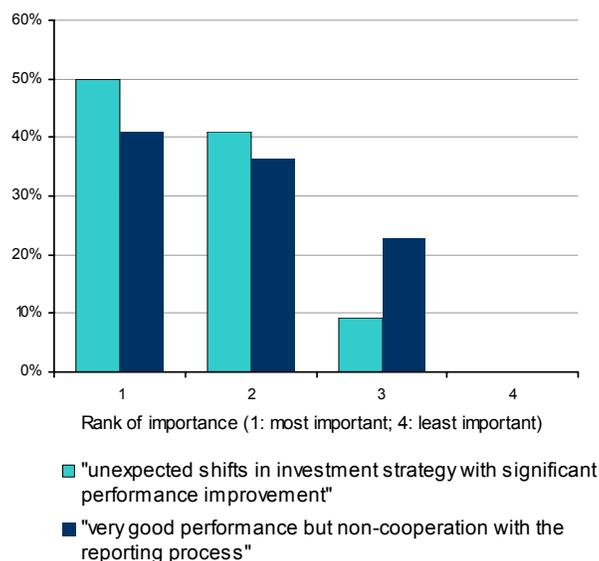


Figure 9: Importance of conflicting criteria for the replacement of hedge fund managers

To summarize, the results in this section suggest the following conclusions. First, the reference-based decision approach is not consistent with the actual decision behavior of the respondents in this survey. Second, conflicting situations seem to be helpful for the decision maker to find the dimension important for him in order to choose between alternatives appearing similar.

Factor weightings and performance

The last part of the study examines three questions. First, it analyzes which basic decision criteria FoF manager agree to look at when managing hedge funds and which criteria they disagree on. Second, the section analyzes if disagreement in the relevance of decision criteria is related to returns. Third, it analyzes if the amount of decision criteria FoF manager consider as important is really relevant for achieving superior returns.

The first problem is approached with a question asking survey participants to weight the relative importance of criteria considered to be important for investment decisions in hedge funds. Since some of the criteria represent issues of general importance, deviations in opinion are not expected. Nevertheless, they have been included as a benchmark facilitating the weighting decision for the rest of the criteria. The management team and its background, the investment

strategy (transparency, cohesiveness etc.), risk policy and management of hedge funds are the kind of general criteria that serve as benchmarks and FoF manager agree on them (see Table 3). In contrast, the track record, age of the hedge fund, the sources of new investment idea, and the systems and infrastructure are decision criteria that are perceived to have ambiguous relevance as decision criteria applied by the FoF managers participating in this survey. Exactly these differences in opinion across managers will be used to explain differences in FoF returns.

N=22	track record	age	team and background	size	investment strategy	sources of investment ideas	hurdle rate	risk policy and management	systems and infrastructure
Mean	0.51	0.32	0.77	0.44	0.69	0.48	0.19	0.74	0.58
Median	0.60	0.30	1.00	0.60	1.00	0.60	0.10	1.00	0.60
Std. Dev.	0.33	0.27	0.39	0.29	0.41	0.37	0.17	0.40	0.37

Remark::

Answers as “most important” have been weighted with 1, answers as “least important” have been weighted with 0.1. Options in the middle receive the weights 0.6, respectively 0.3.

Table 3: Statistics on factor weightings

To address this issue, the products of each FoF company have been screened in order to detect a multi-strategy fund with the highest year-to-date (31.12.2002–31.08.2003) net return in USD. Figure 10 shows the return distribution of the selected FoF products.¹⁴ The sample mean is 6.06% which is slightly higher than the year-to-date return of CSFB/Tremont investable multi-strategy hedge fund index, which is 5.33%.

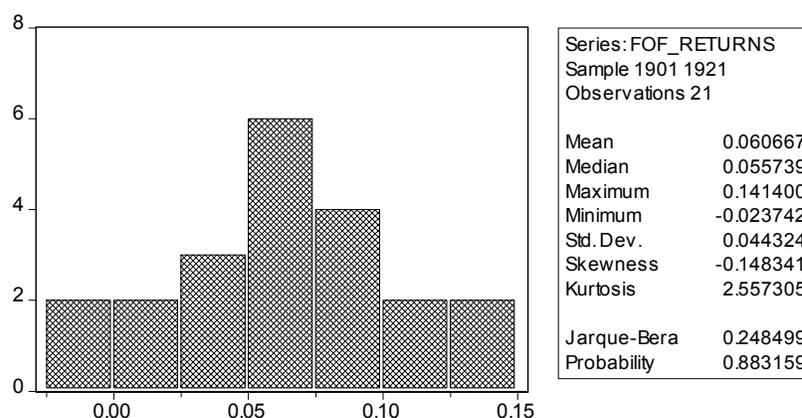


Figure 10: Histogram of returns of selected fund of hedge funds

To develop an intuition on the question, if differences in FoF returns are related to the way FoF managers perceive the relevance of decision variables, the corresponding values are plotted in Figure 11. The higher the dispersion of opinion is, the higher is the variance in returns explained by a linear regression, i.e. the highest R^2 have regressions run on the relative importance of criteria such as the size of hedge funds, the sources of new investment ideas and the hurdle rate. On the other hand, the explanation power of decision criteria such as the track record of the hedge funds, its management team and background, risk policy and management is relatively low, because respondents do not differ in their opinion on the relative importance of these decision criteria. In other words, differences in FoF returns can not be explained by differences in the way how FoF managers evaluate the importance of risk management issues compared to

¹⁴ The data are provided by Eurekaledge Pte Ltd.

criteria for which there is no general agreement on their relevance.

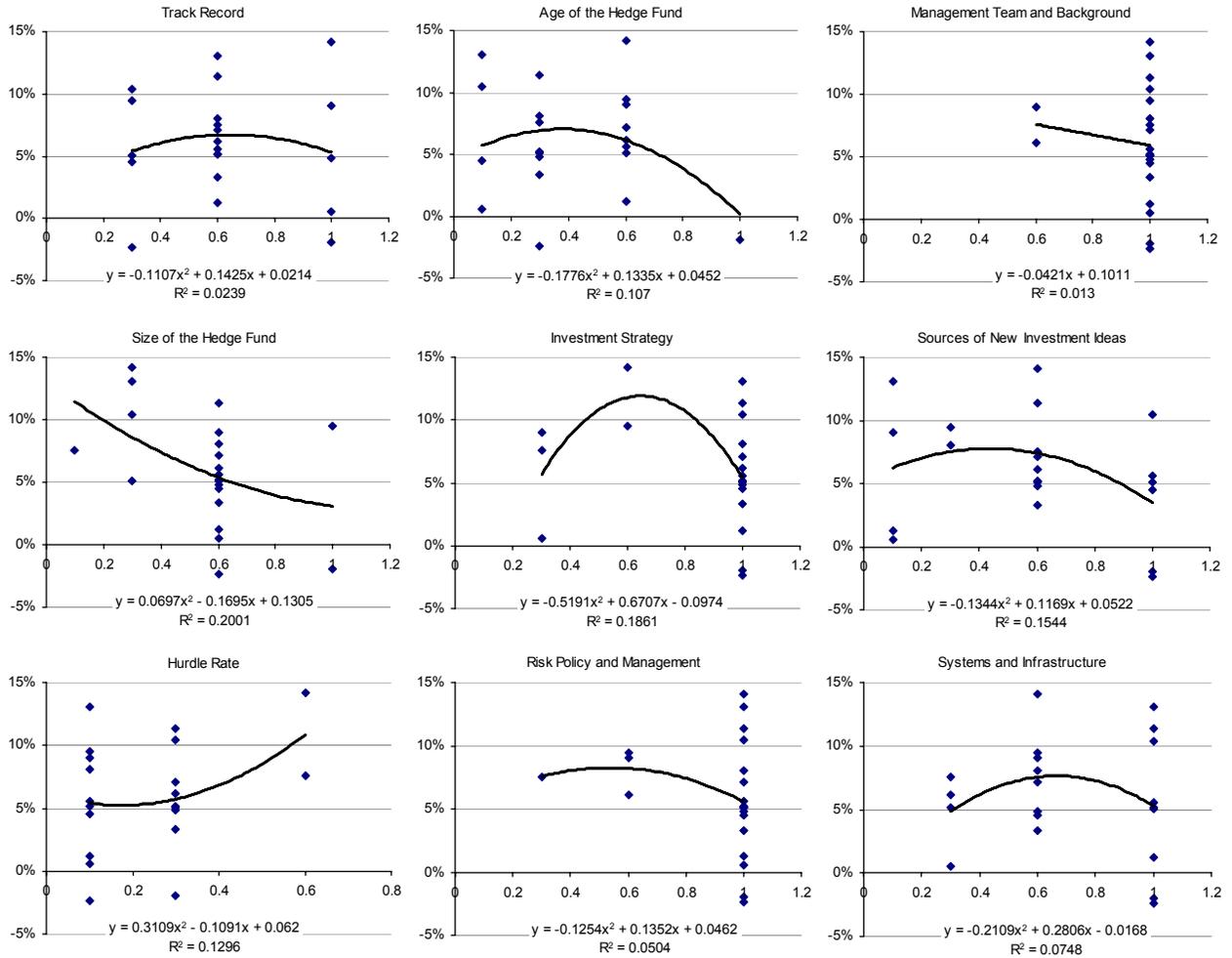


Figure 11: Factor weightings and performance

To compare the explanation power of the decision criteria with the highest R^2 in single regressions, the variables are analyzed in a multi-variable OLS framework. The results are presented in Table 4. None of the variables is statistical significant at the 90% level, although the R^2 is relatively high for a cross-sectional sample.

Dependent Variable: FOF RETURNS
Method: Least Squares
Included observations: 21 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.112	0.0394	2.842	0.011
Hedge Fund Size	-0.071	0.0490	-1.453	0.164
Sources of New Ideas	-0.045	0.0287	-1.563	0.136
Hurdle Rate	0.063	0.0687	0.921	0.370
R-squared	0.2992	Mean dependent var		0.0606
Adjusted R-squared	0.1755	S.D. dependent var		0.0443
S.E. of regression	0.0402	Akaike info criterion		-3.4179
Sum squared resid	0.0275	Schwarz criterion		-3.2189
Log likelihood	39.8882	F-statistic		2.4198
Durbin-Watson stat	1.6682	Prob(F-statistic)		0.1017

Table 4: Multi-variable OLS

Overall, the results show a weak relationship between the weighted decision criteria and the FoF returns. One possible reason for this result is that FoF managers estimate the performance contribution of the whole bottom-up investment process to be at about 50%. Another possible explanation for the weak relationship is the data selection problem. It is possible that the decision criteria weighting are not applied equally by all particular FoF products.

Since the perspective of analyzing the relevance of particular decision criteria did not provide interpretable results on the relationship between decision behavior and returns, it seems reasonable to change the viewpoint and study the preferences of individuals one by one and compare them to performance. The main question in this context is, whether FoF managers considering their preferences and weighting the relevance of the decision criteria accordingly, achieve higher returns than managers who perceive all the criteria as very important.

To test this conjecture, the sum of all weights provided by the FoF manager is regressed on the FoF returns using a simple OLS. The results are provided in Table 5. The more criteria a manager perceives to be of highest importance, the larger the sum of the weights is. The results suggest that the more weights a manager puts on the decision criteria, the worse are the corresponding returns. This relationship is significant at the 90% confidence level.

Dependent Variable: FoF RETURNS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.158565	0.054828	2.892026	0.0101
Sum of weights	-0.017909	0.009282	-1.929492	0.0705
R-squared	0.179653	Mean dependent var		0.054126
Adjusted R-squared	0.131397	S.D. dependent var		0.040870
S.E. of regression	0.038091	Akaike info criterion		-3.598402
Sum squared resid	0.024665	Schwarz criterion		-3.498987
Log likelihood	36.18482	F-statistic		3.722940
Durbin-Watson stat	2.112270	Prob(F-statistic)		0.070532

Table 5: Sum of weightings and returns

Additional aspects of this relationship are found when looking at the scatter-plot of the decision weights and return realizations. As Figure 12 shows, there is a range of optimal “scores” one can use to sign the relevance of several decision criteria in order to achieve relatively high returns on average. The minimum of this score is at 4 and the maximum is at about 5.5. Beyond these score values, the amount of information is either too scarce or there is an information overload that impedes an optimal decision making in terms of returns.

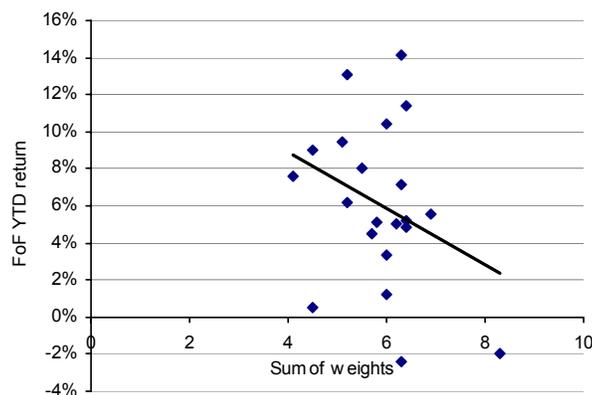


Figure 12: Optimal amount of decision criteria

CONCLUSIONS

This study had two goals. The first one was to examine the question whether professionals use simple heuristics documented in several experimental studies and to analyze the inherent consistency of their decisions; the second one was to test, if differences in opinions regarding the relevance of particular decision criteria, including such based on heuristics, can explain differences in FoF returns. The analysis represents a different approach of evaluation of decision-making processes in comparison to previous experimental studies. It is based on the idea to judge investors' decisions not on their consistency with axioms of rationality, but according to their contribution of particular investors' goals.

The results of the survey provide evidence that professional FoF managers have a biased perception of randomness, change preferences in dependence on the context, but make proper use of the law of probability. Personal experience and feelings are of particular importance, i.e. negative information signals receive a higher decision weight if they are based on personal experience than on other decision criteria. When monitoring hedge funds, FoF managers do not seem to adjust their preferences toward a state dependant reference point. Situations of conflict between alternatives appearing of similar importance are not perceived as confusing. On the contrary, they are helpful for managers to find the dimension that is important for them in order to make decisions.

The effect of a biased perception of randomness matures in a mistaken believe of consequential dependence. As a consequence, FoF managers may overestimate the relevance of track records while selecting hedge fund managers and achieve on average lower returns. The data does not provide statistically significant evidence for this effect. Instead, the data supports the conclusion that the more criteria FoF managers consider as important, the lower their fund returns are. Although the optimal mix of weighted criteria is unknown, the test results point out that it has at least bounds. Even if at some time or other FoF managers remember to have attended to many different decision factors, they maybe fail to notice that there are seldom more than few of them that determine superior returns.

The study provides insights on the question concerning how consistent the professional decision behavior in different contexts is, do they agree on which and how much information they use and if it is relevant for returns. The results might be useful for modeling the behavior of professionals in the context of uncertainty associated with the optimality of various decision rules.

REFERENCES

- Agarwal, Vicas and Narayan Y. Naik (2000): Generalised style analysis of hedge funds, *Journal of Asset Management*, Vol. 1, No. 1, pp. 93–109
- Agarwal, Vicas, Naveen D. Daniel, and Narayan Y. Naik (2003): Flows and performance in the hedge fund industry, Working Paper
- Alternative Investment Management Association (2002): Guide to sound practices for European hedge fund managers
- Amin, Gaurav M. and Harry M. Kat (2002): Hedge fund performance 1990–2000. Do the ‘money machines’ really add value?, *Alternative Investments Research Center*, Working Paper No. 0001
- Barberis, Nicholas and Richard Thaler (2002): A survey of Behavioral Finance, NBER Working Paper No. 9222
- Berk, Jonathan B. and Richard C. Green (2002): Mutual fund flows and performance in rational markets, NBER Working Paper No. 9275
- Brown, William O. and Raymond D. Sauer (1993): Does the basketball market believe in the hot hand? Comment, *The American Economic Review*, Vol. 83, No. 5, pp. 1377–1386
- Brown, Stephen J., William N. Goetzmann, and Bing Liang (2003): Fees on fees in funds of funds, NBER Working Paper 9464
- Camerer, Colin F. (1989): Does the basketball market believe in the “hot hand”?, *The American Economic Review*, Vol. 79, No. 5, pp. 1257–1261
- De Bondt, Werner F. M. and Richard H. Thaler (1994): Financial decision-making in markets and firms: a behavioral perspective, NBER Working Paper No. 4777
- Frederick, Shane (2002): Automated choice heuristics, in Gilovich, Thomas, Dale Griffin, and Daniel Kahneman: *Heuristics and Biases. The Psychology of Intuitive Judgment*, Cambridge University Press
- Fung, William, and David A. Hsieh (1997): Empirical characteristics of dynamic trading strategies: The case of hedge funds, *Review of Financial Studies*, Vol. 10, No. 2 (April), pp. 275–302
- Gilovich, Thomas, Robert Vallone, and Amos Tversky (1985): The hot hand in basketball: on the misperception of randomness, *Cognitive Psychology*, Vol. 17, pp. 295–314
- Heisler, Jeffrey (1994): Recent research in Behavioral Finance, *Financial Markets, Institutions, and Instruments*, Vol. 3, No. 5, pp. 76–105
- Hirshleifer, David (2001): Investor psychology and asset pricing, Ohio State University Working Paper
- Ineichen, Alexander M. (2002): Do fund of hedge fund managers add value, *Journal of Wealth Management*, Vol. 5, No. 1, pp. 8–15

Kahneman, Daniel (1991): Judgment and decision making: a personal view, *Psychological Science*, Vol. 2. No. 3, pp. 142–145

Lhabitant, François-Serge and Michelle Learned (2002): Hedge fund diversification: How much is enough, FAME Working Paper No. 52

Lhabitant, François-Serge (2003): Hedge funds: myths and limits, John Wiley and Sons Ltd.

Liang, Bing (2003): On the Performance of Alternative Investments: CTAs, Hedge Funds, and Funds-of-Funds, Case Western Reserve University, Working Paper

Macho-Stadler, Inés and J. David Pérez-Castillo (2001): An introduction to the economics of information. Incentives and contracts, 2nd edition, Oxford University Press

Rieskamp, Jörg and Ulrich Hoffrage (1999): When do people use simple heuristics, and how can we tell? In Gigerenzer, G. Peter M. Todd, and the ABC Research Group: Simple heuristics that make us smart, Oxford University Press

Schwarz, Norbert (2002): Feelings as information: moods influence judgments and processing strategies, in Gilovich, Thomas, Dale Griffin, and Daniel Kahneman: *Heuristics and Biases. The Psychology of Intuitive Judgment*, Cambridge University Press

Sharpe, Marc J. (1999): Constructing the optimal hedge fund of funds, *Journal of Wealth Management*, Vol. 2, No. 1, pp. 35–44

Siegel, Sidney and N. John Castellan (2001): Nonparametric statistics for the Behavioral Sciences, 2nd edition, McGraw-Hill Inc.

Siegmann, Arjen and André Lucas (2002): Explaining hedge fund investment styles by loss aversion: a rational alternative, Timbergen Institute Discussion Paper 046/2

Sirri, Eric .R. and Peter Tufano (1998): Costly search and mutual fund flows, *Journal of Finance*, Vol. 53, No. 5, pp. 1589–1622

Shanteau, James (1992a): Expert judgment and financial decision making, Working Paper Kansas State University

Shanteau, James (1992b): How much information does an expert use? Is it relevant? *Acta Psychologica*, Vol. 81, pp. 75–86

Stephan, Ekkehard and Guido Kiell (1999): Decision processes in professional investors: does expertise moderate judgment biases?, Working paper presented at the 29th EMAC Conference

Tversky, Amos and Daniel Kahneman (1971): Belief in the law of small numbers, *Psychological Bulletin*, Vol. 2, pp. 105–110

Tversky, Amos and Daniel Kahneman (1983): Extensional versus intuitive reasoning: the conjunction fallacy in probability judgment, *Psychological Review*, Vol. 90, No. 4, pp. 293–315

Tversky, Amos and Daniel Kahneman (1991): Loss aversion in riskless choice. A reference-dependant model, *The Quarterly Journal of Economics*, Vol. 106, No. 4, pp 1039–1061

Wisard, Patric H. (2003): Monitoring Fund of Hedge Funds – ensuring quality, *SwissHedge*, 2nd quarter

APPENDIX A

The significance of change in behavior can be tested either with the *McNemar* test or with the *Binomial* test. These tests are preferred to the t-test because the study uses two related samples (the same subjects decide twice). The individuals' responses are represented in a table similar to the following one.

	“skills-future performance” <i>medium to strong</i>	“skills-future performance” <i>very strong to perfect</i>
Preference for Manager B	10	6
Indifference between managers	3	2

The null hypothesis is that the number of individuals with consistent behavior in each category is equally likely. That is, from the 11 FoF managers with consistent behavior, we would expect 11/2 to behave consistently. In the McNemar test for the significance of consistent behavior we are only interested in the cells in which this is true. The null hypothesis is tested by using the following statistic:

$$X^2 = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i}$$

where O_i is the observed number of cases in the i th category, E_i is the expected number of cases in the i th category when the null hypothesis is true, and k is the number of categories.

The sampling distribution of X^2 is asymptotically distributed as chi square with degree of freedom equal to $k-1$. For the data in this study:

$$X^2 = \frac{(10-12/2)^2}{12/2} + \frac{(2-12/2)^2}{12/2} \approx 5.33$$

with df=1

Thus, the null hypothesis can be rejected at the 95%-confidence level.

The sampling distribution of X^2 is well approximated by the chi-square distribution only when the sample size is large. For small samples, the approximation is poor. If the expected frequency for the McNemar test is very small (that is less than 5), the binomial test should be used (Siegal and Castellan, 2001). In this case, the null hypothesis is that the sample of N=12 comes from a binomial population where $p=q=1/2$. For N=12 and x=2 (the smaller of the two frequencies observed) the probability under the null hypothesis is 0.019, which, when doubled, yields the probability of associated with a two-tailed test, which is 0.028. Thus, the null hypothesis is rejected at the 95%-confidence level.

APPENDIX B

An essential feature of the prospect theory of Kahneman and Tvesky is that the utility is a concave function of the magnitude of physical changes. The value of a particular change is dependant on a initial position or a reference point. Since the marginal value of changes generally decreases with their magnitude, small physical changes have a larger value impact than larger changes.

Let x and y be changes in payoffs and $U(.)$ be a value function for changes in wealth ($U''(x) > 0$ for $x < 0$). Assume that in $t=1$ $x < 0$. The value associated with this change is $U(-x)$. A subsequent negative change in wealth compared to the initial position is associated with a value loss equal to $U(-y)$. Its marginal value decreases with the magnitude of changes in wealth, so that $U'(-y) < U'(-x)$. If $x=y$ $U'(-x-x) < U'(-x)$. Assume that in $t=1$ the subject accustom to the new situation. If he/she adapt completely to recent losses he/she would change his/her reference point accordingly. In this case, a subsequent change in wealth ($-y$) has a different impact on value, which is $U^*(-y)$. Because of the curvature of the value function, $U^*(-y) > U(-y)$. In other words, the same negative change of wealth is associated with a larger value loss if the person perceives the situation as a new steady state and adapts his reference point accordingly.

