Papers

Funds of funds versus simple portfolios of hedge funds: A comparative study of persistence in performance

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Practical applications

Institutional investors can select hedge funds and construct their own FOFs rather than buying pre–packaged FOFs. We attempt to show that investors can avoid a second layer of management and performance fees, which can dig into performance, by showing that it is easy to construct simple equal–weighted portfolios of hedge funds whose performance characteristics dominate those of the largest fund of funds. We also highlight how investors can compare the performance of the two investment possibilities using three different measures: the alpha, the Sharpe ratio and the Information ratio. Finally, we reveal that there exists sufficient persistence in returns, especially for Non–Directional strategies, so that institutional investors can create simple portfolios of hedge funds that outperform the best FOFs based on all three measures.

Abstract

We construct simple portfolios of hedge funds whose performance characteristics dominate those of funds of funds using three different measures: the alpha, the Sharpe ratio and the Information ratio. Portfolios made up of non-directional funds with the highest Information ratios and/or Sharpe ratios are likely to exhibit a significant amount of persistence and continue to dominate the best funds of funds on all three performance measures. The large risk exposure of directional hedge

fund strategies, however, makes them less likely to dominate funds of funds, even when combined with non-directional hedge funds strategies. Overall, these results seem to imply that the extra layer of fees paid to fund of fund managers are largely unmerited, as we can create portfolios of funds, using simple portfolio construction rules and readily available market information, that greatly outperform the best Fund of Funds.

INTRODUCTION

The benefits of including hedge funds in traditional portfolios comprised solely of equities and bonds is now well documented in the literature. The enhancement of risk/return features of these portfolios when hedge funds are added is a well-known stylised fact, mainly due to the negative, low or zero correlation hedge funds possess when compared with stock and bond market indices, and their ability to generate positive returns irrespective of market environments and market cycles. This has been demonstrated, among others, by Amin and Kat,[1] Fung and Hsieh,[2] Agarwal and Naik[3] and Schneeweis and Martin[4] over various time periods and using different hedge fund databases. The decision that investors are now faced with is no longer whether to include this asset class to enhance the performance of traditional portfolios, but rather what is the most effective manner of incorporating it. Investors wishing to commit themselves to hedge funds are faced with a dilemma. On the one hand, funds of hedge funds (FoF) are the safest and simplest way to invest in

hedge funds, because the FoFs manager performs the due diligence, regular monitoring and performance evaluation of the individual funds on behalf of investors, including collection of monthly return and net asset value (NAV) information. Moreover, FoFs produce returns that are usually less volatile than those of individual hedge funds. On the other hand, investors pay a premium for the safety and benefits of FoFs, in terms of an extra layer of fees charged by the FoFs manager, which can be substantial. To further complicate matters, Brown *et al.*[5] show that the triggering of incentive fees and of high water marks of FoFs can vary depending on when investors enter the FoF.

The alternative to investing in a FoF is to select a small pool of individual funds that will provide similar characteristics to the FoFs. Of course, investors adopting this strategy will need to perform the due diligence and regular monitoring of the individual hedge funds. For institutional investors willing to commit large amounts of capital to hedge funds, these costs, however, would be small compared to the extra layer of fees charged by FoFs.

In this paper, we propose a simple strategy to construct portfolios of hedge funds whose risk/return characteristics dominate those of FoFs. Considering that any reasonable contender of funds of funds portfolios would argue that these vehicles offer a trade-off between absolute abnormal performance and risk exposures, one has to be careful in defining the notion of domination in performance. Should it be a model-free performance measure that is widely accepted by financial practice? In this case, the Sharpe ratio is a relevant benchmark. If one considers an absolute percentage return obtained in addition to the required return on the financial markets, then one would consider the

alpha, measured against a properly designed returns generating model, as the adequate performance metrics. But many practitioners would argue that the real skill of the fund manager should be measured with respect to the additional residual risk that he/she accepts to bear: the Information ratio is then the relevant measure to use. As a matter of fact, one could argue that different classes of hedge funds would exhibit different levels of comparative advantages with respect to each of these performance measures, but none should be able to dominate all the others in an absolute fashion. The purpose of this paper is to provide a practical answer to this last question.

The portfolios we construct contain a maximum of four hedge funds, equally weighted in the portfolio, making it possible for individual investors to adopt our methodology. The information used for fund selection is restricted to size and past performance. This paper lies on both sides of two important strands of literature on hedge funds, portfolio construction and performance persistence.

We observe that a strategy that selects the best non-directional funds is very likely to dominate portfolios of funds of funds on all three performance measures. The portfolios display a significant amount of persistence when performance is measured with the Sharpe ratio or the Information ratio. This makes the portfolios attractive alternatives to FoFs, which only show persistence in alphas but without sufficient performance levels to favourably compare to the best hedge funds portfolios. The large risk exposure of directional hedge fund strategies does not make them likely to dominate funds of funds, even when combined with non-directional hedge funds.

METHODOLOGY

Portfolio construction

Unconditional portfolio selection

The study will be comprised of two parts. A first examination will compare the performance of portfolios of directional and non-directional funds without using any past performance measures to select the 'best possible' funds. All possible combinations of equal-weighted portfolios comprising up to four hedge funds will be created and compared to the performance of the funds of funds over the entire sample period. The performance measures that will be employed for the comparison are the Sharpe ratio, the alpha of a nine-factor model and the Information ratio. The motivation behind the choice of these performance measures is detailed in the section 'The performance measures'.

Conditional portfolio selection

In the second part of study, we seperate the nine-year observation period into two equal sub-periods of 4.5 years each: January 1995–June 1999 (period 1) and July 1999–December 2003 (period 2). We assume the perspective of a forward-looking investor at June 1999 with 4.5 years of historical data who is considering what investments to undertake for the next 4.5 years.

At this point in time, the investor has witnessed an unambiguous bullish trend on the stock market. Although we know *ex post* that the subsequent sub-period has been characterised by a further expansion of the technology bubble (until March 2000) followed by a sharp market downturn, we commit not to make use of this hindsight for the portfolio selection strategy. Therefore, we calculate the three performance

measures of each fund over the first sub-period, and use this information to condition the funds that we incorporate in our portfolios over the second sub-period. We then compare the performance of the portfolios of hedge funds against the funds of funds over the second sub-period using the same three performance measures.

The underlying hypothesis is that there exists some persistence in the performance of hedge funds over time, although the literature on the performance persistence of hedge funds points to more ambiguous conclusions. Where persistence has been found, it is usually in the short term (yearly or quarterly), or, unfortunately, due to losing hedge funds continuing to lose, rather than to winning hedge funds continuing to succeed[6,7] and is heavily dependent on the time period and the database employed.[8] Brown et al.[9] find winning managers to repeat their winning performance in only one-half of the years. Even after accounting for size and fees, no consistent pattern of persistence was found. The results are, however, heavily dependent on the method used, the measure used to evaluate performance, the time period under consideration and the database employed. Our study indicates that there exists some significant persistence in performance, but it is quite sensitive to the performance measure that is employed.

Our persistence analysis focuses on abnormal returns recorded in two different market settings: a bullish period and a bearish period. The underlying justification for this choice is simple. If a ranking scheme (ie a method for classifying and selecting funds on the basis of a particular criterion) produces persistent results in extreme market conditions, then these results are likely to obtain in less contrasted periods.

The performance measures

We evaluate the performance of the different funds using three different measures: the Sharpe ratio, the alpha of a multi-factor model and the Information ratio.

The Sharpe ratio is calculated as the ratio of the excess return divided by the standard deviation of returns.

$$SR_i = \frac{r_{i,t}}{\sigma_r} \qquad (1)$$

The alpha and the Information ratio are obtained from the regression of the fund returns against nine market factors. The returns generating model is a combination and an extension of Carhart's[10] four-factor model, the model used by Agarwal and Naik[3] and the ones used by Capocci and Hübner.[11]

This model contains the market risk premium, Carhart's[10] 'size', 'value' and 'momentum' factors, two factors introduced by Agarwal and Naik,[3] one for non-US equities investing funds and one to account for the fact that hedge funds invest in US and foreign bond indices, and two factors that Capocci and Hübner[11] proved to be highly significant, one for the emerging bond market, and one for the commodities market. Furthermore, we add an additional risk premium related to the risk premium associated with high-yield dividend paying stocks. The choice of this additional candidate factor is motivated by the hypothesised positive relationship set forth by Litzenberger and Ramaswamy,[12,13] theoretically explained by tax differential arguments. Christie[14] finds that this hypothesis of a significant dividend risk premium was reinforced for zero-dividend stocks.

Specifically we run the following regression:

$$
\begin{aligned}
r_{i,t} = \alpha_i &+ \beta_{i,1} Mkt_t + \beta_{i,2} SMB_t + \beta_{i,3} HML_t \\
&+ \beta_{i,4} UMD_t + \beta_{i,5} WXUS_t + \beta_{i,6} WGB_t \\
&+ \beta_{i,7} EMB_t + \beta_{i,8} GSC_t \\
&+ \beta_{i,9} HDMZD_t + \varepsilon_{i,t}
\end{aligned} \tag{2}
$$

where $r_{i,t}$ is the fund return in excess of the 13-weeks T-Bill rate for the ith fund, Mkt_t is the excess return on the portfolio obtained by averaging the returns of the Fama and French[15] size and book-to-market portfolios, SMB_t is the factor-mimicking portfolio for size ('Small Minus Big'), HML_t is the factor-mimicking portfolio for the value premium (*High minus Low book-to-market value of* equity), UMD_t is the factor-mimicking portfolio for the momentum effect (*Up Minus Down*), $WXUS_t$ is the return on the MSCI World excluding US Index, WGB_t is the return on the Salomon World Government Bond Index, EMB_t is the return on the JP Morgan Emerging Market Bond Index, GSC_t is the return on the Goldman Sachs Commodity Index and $HDMZD_t$ (*High Dividend minus Zero Dividend*) represents the differential between equally weighted monthly returns of the top-30 per cent quantile stocks ranked by dividend yields and of the zero-dividend yield stocks.
The alpha is obtained by taking the intercept of this regression.

The Information ratio (IR) is defined as the alpha as estimated from the multi-factor model presented above, divided by standard deviation of the residual error from the multi-factor regression. More formally,

$$
IR_i = \frac{\alpha_i}{\sigma_i} \tag{3}
$$

Our premise for selecting these three performance measures is that we expect them to capture the different characteristics of our three fund types. Specifically, we believe the alphas will vary substantially across the three categories of funds as they will have very different factor loadings. We would expect directional ('D') funds will have the most significant loadings to the factors, followed by funds of funds ('FoFs') and then non-directional ('ND') funds. We might therefore expect higher alphas from the two latter fund types. The Sharpe ratio, which favours well-diversified funds, should be highest for FoFs, and we would expect the ND funds to outperform D funds using this measure due to the higher volatility and cyclical nature of the returns of D funds. The IR should be highest for D funds due to their significant factor loadings, reducing their residual variance, and we would expect the ND funds to be the worst performers using this measure for the opposite reason.

DATA

The data consists of monthly returns, net of all fees, of hedge funds in the HFR database (Hedge Fund Research, Inc., 2003), from January 1995 to December 2003. The HFR database contains performance and managerial information on roughly 2,300 hedge funds worldwide in operation on December 2003. In this paper, we separate the data into three sub-categories — non-directional funds, directional funds and fund of funds. Following Agarwal and Naik,[6,16] we define non-directional and directional funds using the following groupings for the strategies identified in the HFR data:

— *Directional*: Market Timing, Emerging Markets, Sector, Equity Hedge, Equity Non-Hedge, Short Sellers, Global Macro and Long Leveraged.

Table 1: Descriptive statistics for the hedge (January1995–December 2002) (a) Surviving funds only and (b) All funds

	Number of funds	Avg. max (%)	Avg. min (%)	Mean (%)	St. Dev. (%)	Skew	Kurtosis
(a)							
First sub-period							
All funds	526	10.58	−11.67	1.234	3.993	−0.7707	6.7302
All hedge funds	368	11.89	−13.01	1.365	4.477	−0.7250	6.6697
Directional funds	226	14.23	−15.72	1.456	5.481	−0.5723	5.7622
Non-directional funds	142	8.15	−8.71	1.221	2.879	−0.9679	8.1139
Fund of funds	158	7.54	−8.54	0.929	2.865	−0.8771	6.8711
Second sub-period							
All funds	449	13.76	−9.08	0.813	4.356	0.4578	5.0681
All hedge funds	306	16.03	−10.76	0.834	5.172	0.3618	4.7094
Directional funds	206	19.33	−13.07	0.830	6.371	0.4500	4.4653
Non-directional funds	100	10.65	−7.00	0.842	3.213	0.2177	5.1079
Fund of funds	143	9.36	−5.80	0.772	2.772	0.6444	5.7656
Entire period							
All funds	427	15.19	−13.91	1.035	4.427	−0.2081	6.8928
All hedge funds	289	18.16	−16.45	1.135	5.343	−0.1222	6.4884
Directional funds	206	20.25	−18.52	1.139	6.092	−0.0774	5.8742
Non-directional funds	83	13.81	−12.15	1.127	3.783	−0.2155	7.7666
Fund of funds	138	9.73	−9.26	0.852	2.746	−0.3659	7.6354
(b)							
First sub-period							
All funds	526	10.58	−11.67	1.234	3.993	−0.7707	6.7302
All hedge funds	368	11.89	−13.01	1.365	4.477	−0.7250	6.6697
Directional funds	226	14.23	−15.72	1.456	5.481	−0.5723	5.7622
Non-directional funds	142	8.15	−8.71	1.221	2.879	−0.9679	8.1139
Fund of funds	158	7.54	−8.54	0.929	2.865	−0.8771	6.8711
Second sub-period							
All funds	449	13.86	−9.69	0.713	4.302	0.4230	6.0745
All hedge funds	306	15.99	−11.44	0.718	5.035	0.3386	5.9140
Directional funds	206	18.92	−13.66	0.687	6.005	0.4142	6.1567

	Number of funds	Avg. max (%)	Avg. min (%)	Mean (%)	St. Dev. (%)	Skew	Kurtosis
Non-directional funds	100	9.96	−6.88	0.781	3.038	0.1829	5.4142
Fund of funds	143	9.29	−5.92	0.704	2.733	0.6037	6.4179
Entire period							
All funds	427	15.86	−14.71	0.992	4.502	−0.2325	7.5916
All hedge funds	289	18.55	−17.08	1.081	5.280	−0.1602	7.2906
Directional funds	206	20.89	−19.32	1.086	6.012	−0.0977	6.8192
Non-directional funds	83	12.74	−11.51	1.069	3.463	−0.3152	8.4608
Fund of funds	138	10.23	−9.74	0.807	2.871	−0.3839	8.2218

This table reports the descriptive statistics of the funds in the HFR database over the entire study period as well as over the two sub-periods. This table only includes funds that reported for (a) the entire 96 months and (b) at least the first 48 months.

— *Non-Directional*: Fixed Income, Convertible Arbitrage, Equity Market Neutral, Relative Value Arbitrage, Event Driven, Distressed Securities and Merger Arbitrage.

Descriptive statistics for the selected funds classifications are presented in Table 1a and b.

Table 1a presents the results for all funds that reported during the entire sample period (96 months). Table 1b presents the results for funds that reported at least during the entire first sub-period (48 months). The first sub-period is our conditioning period, therefore Table 1a can be interpreted as the descriptive statistics with survivorship bias, whereas Table 1b includes the funds that stopped reporting during sub-period 2. In our out-of-sample performance analysis, we will be using the funds reported in Table 1b.

In Table 1a and b, we present the descriptive statistics for all the funds as well the different categories over the entire sample periods as well

as the two sub-periods. For each period and category, we report the average maximum monthly return, the average minimum monthly return, the average monthly return, the average standard deviation, the average skewness and the average kurtosis. In order to ensure that both the alpha and Information ratio are relatively robust, we only keep the funds that have an R^2 greater than 0.20.

Comparing Table 1a and b, we notice that the pattern of the results is very similar. During the first sub-period, the average returns of the hedge funds and funds of funds was greater than for period two. This is hardly surprising as these 48 months are characterised by a strong bull market. Although in theory this should not affect the performance of non-directional funds, the results indicate that they are not immune to changing market conditions. Although their performance in the second sub-period, which includes the collapse of the dot-com bubble, is

lesser, the impact on their returns is less dramatic than for directional strategies. Specifically, the returns of non-directional funds drop by 38 basis points per month whereas the returns of directional strategies lose 62 basis points per month. The returns of the funds of funds are the least affected, giving up only 15 basis points (Table 1a). The impact on the volatility of returns is less important with only a slight increase observed over the two sub-periods.

Over the entire sample, we notice that on average all hedge funds, independent of the classification, exhibit negative skewness and positive excess kurtosis. This is a well-documented characteristic of hedge fund returns; however, it is interesting to note the extremely different behaviour of the higher moments over the two sub-periods. In both Table 1a and b, we notice that although the excess kurtosis is always positive, the skewness coefficient is sensitive to market conditions. During the bullish sub-period, the strategies all exhibit negative skewness, whereas during the more bearish sub-period skewness coefficients all become positive (although smaller in magnitude).

Finally, it is important to note the difference between Table 1a and b. In both tables, the results include funds that have reported during (at least) the entire first period, so predictably the results for the first sub-period are identical. Funds in Table 1a are selected such that they also reported during the entire second period whereas funds in Table 1b might have stopped reporting any time during sub-period two. In effect, the results in Table 1a represent a sub-sample of the results in Table 1b (surviving funds only). It is therefore not surprising to find a greater number of funds in Table 1b, and also to find that the results are less strong. If we compare the sub-period two in both tables, we notice that returns in Table 1a are 10 basis points lower per month for the entire hedge fund sample. This survivorship bias is greatest for directional funds (15 basis points), and lowest for non-directional funds (6 basis points).

EMPIRICAL RESULTS

Global analysis

Table 2a and b present the performance measures of all funds, as well as by category (FoF, ND and D), over the entire sample period, and for the two sub-period. Table 2a presents the performance measures for the funds that survived the entire sample period, whereas Table 2b includes funds that reported for at least the entire first sub-period.

Over the entire period, we notice that the Fund of Funds outperformed the single strategy funds in terms of Sharpe ratio and Information ratio; however, hedge funds presented a higher mean alpha. When we separate the hedge funds into Directional and Non-Directional strategies however, the relative performance of the Funds of Funds is less impressive. In fact, we find that the Non-Directional funds provide the highest alphas, Information ratios, as well as Sharpe ratio. The results are similar when we consider the two sub-periods. They indicate that the best performance on all three measures is obtained among ND funds in both sub-periods. In both periods, however, ND funds have higher Sharpe ratios and Information ratios than D funds. Note that the standard deviation of each performance measure is high, so that an investor cannot expect to beat the FoF strategies by randomly picking among ND and D funds.

Now that we have an idea of the overall performance of the different fund styles for the

Table 2: Performance measures of funds of funds: (a) hedge funds (January 1995–December 2002) and (b) non-directional and directional hedge funds over the whole sample period and the sub-periods for the funds that reported during the entire first sub-period (January 1995–June 1999)

	Sharpe				Alpha				Information Ratio			
	Max	Min	Mean	Std	Max	Min	Mean	Std	Max	Min	Mean	Std
(a)												
First sub-period												
All funds	1.722	−0.265	0.276	0.231	0.051	−0.038	0.002	0.009	1.839	−0.659	0.106	0.300
All hedge funds	1.281	−0.251	0.286	0.222	0.051	−0.038	0.003	0.010	1.413	−0.659	0.132	0.282
Directional funds	0.982	−0.251	0.232	0.195	0.051	−0.038	0.002	0.011	0.850	−0.659	0.050	0.221
Non-directional funds	1.281	−0.084	0.373	0.237	0.020	−0.031	0.005	0.007	1.413	−0.497	0.262	0.320
Fund of funds	1.722	−0.265	0.254	0.250	0.023	−0.021	−0.001	0.007	1.839	−0.496	0.046	0.331
Second sub-period												
All funds	1.319	−0.337	0.205	0.254	0.068	−0.044	0.004	0.008	1.181	−0.321	0.155	0.240
All hedge funds	1.319	−0.213	0.189	0.262	0.068	−0.044	0.004	0.010	1.181	−0.294	0.152	0.248
Directional funds	0.682	−0.213	0.115	0.175	0.068	−0.044	0.004	0.011	0.651	−0.269	0.092	0.167
Non-directional funds	1.319	−0.208	0.311	0.328	0.021	−0.022	0.004	0.006	1.181	−0.294	0.250	0.318
Fund of funds	1.156	−0.337	0.237	0.235	0.041	−0.009	0.003	0.005	1.109	−0.321	0.161	0.226
Entire period												
All funds	0.910	−0.137	0.207	0.158	0.041	−0.028	0.003	0.006	0.891	−0.319	0.116	0.179
All hedge funds	0.882	−0.137	0.194	0.152	0.041	−0.028	0.004	0.008	0.891	−0.319	0.114	0.177
Directional funds	0.524	−0.137	0.156	0.125	0.041	−0.028	0.003	0.008	0.530	−0.241	0.076	0.133
Non-directional funds	0.882	−0.068	0.274	0.171	0.017	−0.013	0.004	0.006	0.891	−0.319	0.193	0.226
Fund of funds	0.910	−0.097	0.231	0.167	0.b021	−0.007	0.002	0.004	0.823	−0.166	0.121	0.184
(b)												
First sub-period												
All funds	1.722	−0.265	0.276	0.231	0.051	−0.038	0.002	0.009	1.839	−0.659	0.106	0.300
All hedge funds	1.281	−0.251	0.286	0.222	0.051	−0.038	0.003	0.010	1.413	−0.659	0.132	0.282
Directional funds	0.982	−0.251	0.232	0.195	0.051	−0.038	0.002	0.011	0.850	−0.659	0.050	0.221
Non-directional funds	1.281	−0.084	0.373	0.237	0.020	−0.031	0.005	0.007	1.413	−0.497	0.262	0.320
Fund of funds	1.722	−0.265	0.254	0.250	0.023	−0.021	−0.001	0.007	1.839	−0.496	0.046	0.331
Second sub-period												
All funds	1.319	−0.390	0.165	0.244	0.068	−0.044	0.003	0.008	1.181	−0.386	0.118	0.232
All hedge funds	1.319	−0.390	0.148	0.249	0.068	−0.044	0.003	0.010	1.181	−0.386	0.111	0.237
Directional funds	0.682	−0.390	0.085	0.172	0.068	−0.044	0.002	0.011	0.651	−0.386	0.056	0.169

Gregoriou, Hübner, Papageorgiou and Rouah ✳

	Sharpe				Alpha				Information Ratio			
	Max	*Min*	*Mean*	*Std*	*Max*	*Min*	*Mean*	*Std*	*Max*	*Min*	*Mean*	*Std*
Non-directional funds	1.319	−0.278	0.276	0.324	0.024	−0.022	0.003	0.006	1.181	−0.294	0.222	0.309
Fund of funds	1.156	−0.337	0.204	0.230	0.041	−0.009	0.002	0.005	1.109	−0.321	0.134	0.220
Entire period												
All funds	0.910	−0.177	0.194	0.162	0.041	−0.028	0.002	0.007	0.891	−0.319	0.098	0.180
All hedge funds	0.882	−0.177	0.187	0.159	0.041	−0.028	0.003	0.008	0.891	−0.319	0.098	0.177
Directional funds	0.663	−0.177	0.151	0.134	0.041	−0.028	0.002	0.008	0.530	−0.241	0.058	0.135
Non-directional funds	0.882	−0.068	0.276	0.180	0.020	−0.013	0.004	0.006	0.891	−0.319	0.196	0.225
Fund of funds	0.910	−0.168	0.209	0.168	0.021	−0.012	0.001	0.004	0.823	−0.240	0.099	0.189

This table reports the Sharpe ratio, alpha and Information ratio for the hedge funds in the HFR database over the period January 1995 to December 2002, as well as for the two sub-periods. We present the statistics for all hedge funds, for directional strategies, for non-directional strategies as well as for Fund of Funds. In this table, we only included funds that reported for (a) the entire 96 months and (b) at least the first 48 months.

overall period and sub-periods, we want to evaluate the relative performance of the hedge funds with respect to the fund of funds. In order to achieve this, we generate equal-weighted containing both directional and non-directional funds, as well as portfolios containing exclusively directional or non-directional strategies. Given the large number of possible permutations with three or four funds, we randomly generate 10,000 'representative' portfolios from our data set for each category. We compare the relative performance of the portfolios for five different sub-groups of the data.

— *All vs Best* — We compare the relevant performance measure of all the funds in the category to that of the best performing fund of fund.
— *All vs Top* 10 *per cent* — We compare the relevant performance measure of all the funds in the category to that of the average of the top 10 per cent of fund of funds.
— *All vs Top* 50 *per cent* — We compare the relevant performance measure of all the funds in the category to that of the average of the top 50 per cent of fund of funds.
— *Top* 10 *per cent vs Top* 10 *per cent* — We compare the relevant performance measure of the top 10 per cent of the funds in the category to that of the average of the top 10 per cent of fund of funds.
— *Top* 50 *per cent vs Top* 50 *per cent* — We compare the relevant performance measure of the top 50 per cent of the funds in the category to that of the average of the top 50 per cent of fund of funds.

Table 3a–c present the results of this analysis over the first sub-period. The second sub-period will be examined out-of-sample in the ensuing persistence analysis.

Table 3a reports the number and percentage of equal-weighted portfolios of all hedge funds, directional funds and non-directional funds that beat the fund of fund in terms of Sharpe ratio based on different ranking criteria. There are two important trends that are observable. First, the results clearly show that portfolios comprised strictly of Directional funds have a much greater probability of outperforming the fund of funds, irrespective of the ranking criteria and the number of funds in the portfolios. Let us first consider the results when portfolios are made up of a single fund. Of the 368 funds in the sample, none beat the Sharpe ratio of the best fund of funds; however, 3.0 per cent of funds beat the average Sharpe ratio of the top 10 per cent of fund of funds (0.9 per cent of Ds and 6.3 per cent of NDs) and 88 funds beat the average of the top 50 per cent (14.2 per cent of Ds and 39.4 per cent of NDs). The results are understandably more impressive when we restrict our analysis to the best performing funds. When we compare the performance of the top 50 per cent of funds to the average of the top-half fund of funds, 28 per cent of Directional funds have a superior Sharpe ratio whereas over 78 per cent of ND funds outperform.

As we increase the number of funds in the equal-weighted portfolios, the percentage of portfolios of funds that outperform the FOFs does not increase systematically. In fact, when we compare the fund performance with the average of the top 10 per cent of FOFs the percentage of portfolios that outperform decreases as the number of funds in the equal-weighted portfolios increases. The opposite trend is observed when we use the average of the top 50 per cent of FOFs as our benchmark.

Table 3b and c present the same analysis using alpha and the Information ratio, respectively, as the performance measure, and the results generally exhibit an even stronger pattern of superior performance by the equal-weighted hedge fund portfolios. We once again observe that restricting our selection of funds to Non-Directional strategies greatly increases the probability of beating the FOFs, and that increasing the number of funds in the portfolios reduces the probability of beating the mean of the top 10 per cent of FOFs but increases the probability of beating the mean of the top 50 per cent.

The next step in our analysis consists in investigating whether we can reliably use performance measures in period 1 to predict which funds or portfolio of funds will perform best in period 2. This study will evaluate the effectiveness of each of the three performance measures at detecting persistence in the different hedge fund strategies. In order to eliminate any survivorship bias, we use the funds presented in Table 1b. In other words, the only restriction imposed is that the funds reported during the entire first period (our conditioning period). The analysis is a three-step procedure. First, we rank the portfolio of hedge funds with respect to a given performance measure in the first period. Next, we select a cross-section of the funds based on their first period ranking (ie top 10 per cent or top 50 per cent) and we calculate the performance of the selected portfolios of funds in the second period using all three performance measures. And finally, we compare the second period performance of the selected funds to that of the funds of funds in the second period.

Table 4a–c report the ranking in the second period of the equally weighted portfolios of directional and non-directional funds compared to the funds of funds.

Table 3: Ranking based on (a) Sharpe ratio, (b) alpha and (c) Information ratio of equally weighted portfolios of hedge funds and funds of funds over the first sub-period (January1995–June 1999)

# of funds in portfolios	Ranking type	All hedge funds			Directional			Non-directional		
		# of funds	# of funds *that beat*	% of funds *that beat*	# of funds	# of funds *that beat*	% of funds *that beat*	# of funds	# of funds *that beat*	% of funds *that beat*
(a)										
1	All vs Best	368	0	0.0	226	0	0.0	142	0	0.0
	All vs Top 10%	368	11	3.0	226	2	0.9	142	9	6.3
	All vs Top 50%	368	88	23.9	226	32	14.2	142	56	39.4
	Top 10% vs Top 10%	36	11	30.6	22	2	9.1	14	9	64.3
	Top 50% vs Top 50%	184	88	47.8	113	32	28.3	71	56	78.9
2	All vs Best	9,602	0	0.0	9,008	0	0.0	7,889	0	0.0
	All vs Top 10%	9,602	108	1.1	9,008	32	0.4	7,889	400	5.1
	All vs Top 50%	9,602	2,129	22.2	9,008	1,413	15.7	7,889	3,225	40.9
	Top 10% vs Top 10%	960	108	11.3	900	32	3.6	788	400	50.8
	Top 50% vs Top 50%	4,801	2,129	44.3	4,504	1,413	31.4	3,944	3,225	81.8
3	All vs Best	9,963	0	0.0	9,940	0	0.0	9,930	0	0.0
	All vs Top 10%	9,963	88	0.9	9,940	51	0.5	9,930	420	4.2
	All vs Top 50%	9,963	2,503	25.1	9,940	1,727	17.4	9,930	4,317	43.5
	Top 10% vs Top 10%	996	88	8.8	994	51	5.1	993	420	42.3
	Top 50% vs Top 50%	4,981	2,503	50.3	4,970	1,727	34.7	4,965	4,317	86.9
4	All vs Best	9,959	0	0.0	9,966	0	0.0	9,957	0	0.0
	All vs Top 10%	9,959	82	0.8	9,966	59	0.6	9,957	392	3.9
	All vs Top 50%	9,959	2,621	26.3	9,966	1,819	18.3	9,957	4,657	46.8
	Top 10% vs Top 10%	995	82	8.2	996	59	5.9	995	392	39.4
	Top 50% vs Top 50%	4,979	2,621	52.6	4,983	1,819	36.5	4,978	4,657	93.6

Table 3: Continued

# of funds in portfolios	Ranking type	All hedge funds			Directional			Non-directional		
		# of funds	# of funds that beat	% of funds that beat	# of funds	# of funds that beat	% of funds that beat	# of funds	# of funds that beat	% of funds that beat
(b)										
1	All vs Best	368	8	2.2	226	8	3.5	142	0	0.0
	All vs Top 10%	368	53	14.4	226	31	13.7	142	22	15.5
	All vs Top 50%	368	154	41.8	226	75	33.2	142	79	55.6
	Top 10% vs Top 10%	36	36	100.0	22	22	100.0	14	14	100.0
	Top 50% vs Top 50%	184	154	83.7	113	75	66.4	71	71	100.0
2	All vs Best	9,602	97	1.0	9,008	141	1.6	7,889	0	0.0
	All vs Top 10%	9,602	716	7.5	9,008	775	8.6	7,889	487	6.2
	All vs Top 50%	9,602	3,723	38.8	9,008	2,904	32.2	7,889	4,405	55.8
	Top 10% vs Top 10%	960	716	74.6	900	775	86.1	788	487	61.8
	Top 50% vs Top 50%	4,801	3,723	77.5	4,504	2,904	64.5	3,944	3,944	100.0
3	All vs Best	9,963	23	0.2	9,940	40	0.4	9,930	0	0.0
	All vs Top 10%	9,963	550	5.5	9,940	637	6.4	9,930	299	3.0
	All vs Top 50%	9,963	3,853	38.7	9,940	2,988	30.1	9,930	5,775	58.2
	Top 10% vs Top 10%	996	550	55.2	994	637	64.1	993	299	30.1
	Top 50% vs Top 50%	4,981	3,853	77.4	4,970	2,988	60.1	4,965	4,965	100.0
4	All vs Best	9,959	5	0.1	9,966	11	0.1	9,957	0	0.0
	All vs Top 10%	9,959	364	3.7	9,966	430	4.3	9,957	148	1.5
	All vs Top 50%	9,959	3,598	36.1	9,966	2,818	28.3	9,957	5,783	58.1
	Top 10% vs Top 10%	995	364	36.6	996	430	43.2	995	148	14.9
	Top 50% vs Top 50%	4,979	3,598	72.3	4,983	2,818	56.6	4,978	4,978	100.0

Table 3: Continued

# of funds in portfolios	Ranking type	All hedge funds			Directional			Non-directional		
		# of funds	# of funds that beat	% of funds that beat	# of funds	# of funds that beat	% of funds that beat	# of funds	# of funds that beat	% of funds that beat
(c)										
1	All vs Best	368	0	0.0	226	0	0.0	142	0	0.0
	All vs Top 10%	368	9	2.4	226	1	0.4	142	8	5.6
	All vs Top 50%	368	100	27.2	226	33	14.6	142	67	47.2
	Top 10% vs Top 10%	36	9	25.0	22	1	4.5	14	8	57.1
	Top 50% vs Top 50%	184	100	54.3	113	33	29.2	71	67	94.4
2	All vs Best	9,602	0	0.0	9,008	0	0.0	7,889	0	0.0
	All vs Top 10%	9,602	86	0.9	9,008	24	0.3	7,889	279	3.5
	All vs Top 50%	9,602	1,851	19.3	9,008	1,064	11.8	7,889	3,484	44.2
	Top 10% vs Top 10%	960	86	9.0	900	24	2.7	788	279	35.4
	Top 50% vs Top 50%	4,801	1,851	38.6	4,504	1,064	23.6	3,944	3,484	88.3
3	All vs Best	9,963	0	0.0	9,940	0	0.0	9,930	0	0.0
	All vs Top 10%	9,963	86	0.9	9,940	45	0.5	9,930	299	3.0
	All vs Top 50%	9,963	1,898	19.1	9,940	1,168	11.8	9,930	4,605	46.4
	Top 10% vs Top 10%	996	86	8.6	994	45	4.5	993	299	30.1
	Top 50% vs Top 50%	4,981	1,898	38.1	4,970	1,168	23.5	4,965	4,605	92.7
4	All vs Best	9,959	0	0.0	9,966	0	0.0	9,957	1	0.0
	All vs Top 10%	9,959	50	0.5	9,966	36	0.4	9,957	235	2.4
	All vs Top 50%	9,959	1.740	17.5	9,966	1,045	10.5	9,957	4,781	48.0
	Top 10% vs Top 10%	995	50	5.0	996	36	3.6	995	235	23.6
	Top 50% vs Top 50%	4,979	1,740	34.9	4,983	1,045	21.0	4,978	4,781	96.0

This table compares the performance in terms of (a) Sharpe ratio, (b) alpha and (c) Information ratio of portfolios of all hedge funds, directional funds and non-directional funds against the performance of the Fund of Funds in the HFR database over the period January 1995–June 1999. Due to the large number of possible portfolios of containing more than one fund, we generate 10,000 equal-weighted portfolios of funds containing 2, 3 and 4 funds. We then eliminate any portfolios that have an adjusted R^2 below 20 per cent when regressed against the factors in the model (equation 2).

Table 4: Out-of-sample performance of equal-weighted portfolios of hedge funds vs Fund of Funds when selection is based on (a) Sharpe ratio (b) alpha and (c) Information ratio

# of funds in portfolios	Ranking type	All hedge funds			Directional funds			Non-directional funds		
		% of funds that beat SR	% of funds that beat alpha	% of funds that beat IR	% of funds that beat SR	% of funds that beat alpha	% of funds that beat IR	% of funds that beat SR	% of funds that beat alpha	% of funds that beat IR
(a)										
1	All vs Best	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	All vs Top 10%	3.5	0.9	3.5	0.0	0.0	0.0	6.5	1.6	6.5
	All vs Top 50%	19.1	13.0	19.1	1.9	1.9	1.9	33.9	22.6	33.9
	Top 10% vs Top 10%	36.4	9.1	36.4	0.0	0.0	0.0	66.7	16.7	66.7
	Top 50% vs Top 50%	38.6	26.3	38.6	3.8	3.8	3.8	67.7	45.2	67.7
2	All vs Best	0.1	0.0	0.1	0.0	0.0	0.0	0.6	0.0	0.6
	All vs Top 10%	2.2	0.2	2.1	0.1	0.1	0.1	7.2	0.7	7.1
	All vs Top 50%	14.9	10.2	14.6	4.7	4.6	4.7	32.7	20.2	31.5
	Top 10% vs Top 10%	22.0	2.2	21.5	0.6	0.6	0.6	71.8	7.0	70.8
	Top 50% vs Top 50%	29.8	20.5	29.1	9.4	9.3	9.4	65.4	40.5	63.0
3	All vs Best	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1
	All vs Top 10%	0.6	0.2	0.6	0.1	0.1	0.1	5.0	0.7	4.7
	All vs Top 50%	13.7	10.9	13.1	5.0	4.7	4.9	31.0	20.1	29.1
	Top 10% vs Top 10%	5.9	2.0	5.9	0.7	0.7	0.7	49.9	6.9	47.2
	Top 50% vs Top 50%	27.5	21.8	26.3	9.9	9.5	9.8	62.1	40.2	58.2
4	All vs Best	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
	All vs Top 10%	0.5	0.2	0.5	0.0	0.0	0.0	3.8	0.4	3.8
	All vs Top 50%	13.5	11.2	12.9	4.7	4.5	4.5	30.7	20.3	29.1
	Top 10% vs Top 10%	5.1	2.3	5.1	0.0	0.0	0.0	38.0	4.5	38.0
	Top 50% vs Top 50%	27.0	22.4	25.9	9.4	9.0	9.0	61.4	40.6	58.2

# of funds in portfolios	Ranking type	All hedge funds			Directional funds			Non-directional funds		
		% of funds that beat SR	% of funds that beat alpha	% of funds that beat IR	% of funds that beat SR	% of funds that beat alpha	% of funds that beat IR	% of funds that beat SR	% of funds that beat alpha	% of funds that beat IR
(b)										
1	All vs Best	0.0	3.5	0.0	0.0	3.8	0.0	0.0	3.2	0.0
	All vs Top 10%	0.9	30.4	5.2	0.0	47.2	3.8	1.6	16.1	6.5
	All vs Top 50%	13.0	48.7	39.1	1.9	58.5	39.6	22.6	40.3	38.7
	Top 10% vs Top 10%	0.0	100.0	18.2	0.0	100.0	20.0	0.0	100.0	33.3
	Top 50% vs Top 50%	26.3	98.2	78.9	3.8	100.0	73.1	45.2	80.6	77.4
2	All vs Best	0.0	0.5	0.0	0.0	0.9	0.0	0.0	0.1	0.0
	All vs Top 10%	0.2	32.7	8.0	0.1	39.7	6.7	0.7	22.6	8.0
	All vs Top 50%	10.2	55.9	46.1	4.6	67.4	48.2	20.2	43.1	40.1
	Top 10% vs Top 10%	0.4	100.0	32.3	0.0	100.0	40.0	0.7	100.0	23.5
	Top 50% vs Top 50%	17.8	100.0	84.6	8.7	100.0	82.5	40.5	86.2	80.1
3	All vs Best	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0
	All vs Top 10%	0.2	34.6	10.4	0.1	37.8	7.2	0.7	25.0	9.0
	All vs Top 50%	10.9	63.9	54.5	4.7	69.9	54.7	20.1	50.1	46.0
	Top 10% vs Top 10%	0.5	100.0	45.5	0.0	100.0	27.0	0.0	100.0	42.7
	Top 50% vs Top 50%	16.8	100.0	90.4	8.2	100.0	89.8	40.1	100.0	91.8
4	All vs Best	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	All vs Top 10%	0.2	31.6	9.9	0.0	38.2	8.7	0.4	19.6	8.3
	All vs Top 50%	11.2	66.7	59.4	4.5	69.0	57.5	20.3	54.2	51.0
	Top 10% vs Top 10%	0.0	100.0	33.5	0.0	100.0	33.3	0.6	100.0	51.4
	Top 50% vs Top 50%	16.9	100.0	94.4	8.4	100.0	92.1	36.2	100.0	94.6

Table 4: Continued

# of funds in portfolios	Ranking type	All hedge funds			Directional funds			Non-directional funds		
		% of funds that beat SR	*% of funds that beat alpha*	*% of funds that beat IR*	*% of funds that beat SR*	*% of funds that beat alpha*	*% of funds that beat IR*	*% of funds that beat SR*	*% of funds that beat alpha*	*% of funds that beat IR*
(c)										
1	All vs Best	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	3.2
	All vs Top 10%	3.5	5.2	13.0	0.0	3.8	3.8	6.5	6.5	21.0
	All vs Top 50%	19.1	39.1	49.6	1.9	39.6	41.5	33.9	38.7	56.5
	Top 10% vs Top 10%	36.4	45.5	100.0	0.0	40.0	40.0	66.7	33.3	100.0
	Top 50% vs Top 50%	38.6	78.9	100.0	3.8	80.8	84.6	61.3	71.0	100.0
2	All vs Best	0.1	0.0	0.8	0.0	0.0	0.1	0.6	0.0	2.7
	All vs Top 10%	2.1	8.0	14.2	0.1	6.7	7.6	7.1	8.0	26.2
	All vs Top 50%	14.6	46.1	57.0	4.7	48.2	50.4	31.5	40.1	62.1
	Top 10% vs Top 10%	21.1	52.9	100.0	0.6	67.7	76.8	60.4	17.5	100.0
	Top 50% vs Top 50%	28.4	82.1	100.0	9.4	95.8	100.0	59.8	67.5	100.0
3	All vs Best	0.0	0.0	0.2	0.0	0.0	0.1	0.1	0.0	1.3
	All vs Top 10%	0.6	10.4	15.9	0.1	7.2	8.0	4.7	9.0	27.2
	All vs Top 50%	13.1	54.5	62.5	4.9	54.7	57.5	29.1	46.0	65.0
	Top 10% vs Top 10%	5.9	66.3	100.0	0.7	72.3	80.1	40.9	29.3	100.0
	Top 50% vs Top 50%	25.9	89.9	100.0	9.8	95.8	100.0	54.4	74.2	100.0
4	All vs Best	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.9
	All vs Top 10%	0.5	9.9	16.3	0.0	8.7	9.3	3.8	8.3	28.1
	All vs Top 50%	12.9	59.4	66.3	4.5	57.5	59.8	29.1	51.0	68.5
	Top 10% vs Top 10%	4.5	59.7	100.0	0.0	87.3	92.9	33.2	23.0	100.0
	Top 50% vs Top 50%	24.0	93.0	100.0	8.9	97.5	100.0	53.0	77.5	100.0

This table shows the percentage of hedge funds (or equal-weighted portfolios of hedge funds) that outperform the Fund of Funds in the second period based on their first period (a) Sharpe ratio ranking, (b) alpha ratio ranking and (c) Information ratio ranking.

These results in Table 4a–c provide strong evidence that selecting a portfolio of hedge funds based on their past performance leads to better results than investing directly in fund of funds. Independently of the performance measure used to select the funds in the first period, the out-of-sample performance in the second period is impressive based on all three performance metrics. Nonetheless, basing our investment on alpha or Information ratio further increases our probability of outperforming the best fund of funds. For example, let us consider the final row of Table 4c. In this instance, we have ranked the equal-weighted portfolios composed of four hedge funds using the Information ratio over the first period. The results indicate that when we chose the top 50 per cent of these portfolios and compare their performance to the average of the top 50 per cent of fund of funds in the second period, there is a 24 per cent chance of obtaining a greater Sharpe ratio, a 93 per cent chance of obtaining a better alpha and a 100 per cent chance of obtaining a greater score in term of Information ratio.

There are no clear conclusions that can be drawn as to the effect of increasing the number of funds or limiting the types of strategies. The results in all three tables show that increasing the number of hedge funds in the equal-weighted portfolios does not always increase the probability of outperforming in the second period, and will on occasion reduce the likelihood of beating the fund of funds. On the other hand, limiting our investment pool to non-directional strategies will generally increase the probability of outperforming the FOFs. Specifically, if our initial ranking is based on the Sharpe ratio (Table 4a) we will always benefit from restricting our investment to non-directional strategies independent of the

performance metric used to evaluate the performance in the second period. This trend is less clear-cut when our performance metric in the first period is the regression alpha or the Information ratio. From the results in Table 4b, we note that when the funds are selected based on first period alpha, the probability of outperforming in terms of the same metric in the second period is higher for Directional funds. The probability of outperforming in the second period based on the Sharpe ratio or Information ratio is, however, always higher if we restrict our investment to Non-Directional. A similar pattern is detected in Table 4c, where based on the first period Information ratio, the Non-Directional funds will perform better in terms of Sharpe and Information ratio in period 2, whereas the Directional funds will tend to provide a higher alpha. Nonetheless, the probability of outperforming the fund of funds remains very high in all cases.

CONCLUSIONS

In this paper, we have shown that it is possible to construct portfolios of Non-Directional and Directional hedge funds that outperform the best Fund of Funds in the HFR database, in terms of alpha, Sharpe ratio and Information ratio. Furthermore, it is not necessary for investors to enter into a large number of hedge funds to accomplish this: we demonstrate that equal-weighted portfolios of no more than four funds are sufficient to dominate the best Fund of Funds. We show that in-sample portfolios of hedge funds greatly outperform fund of funds irrespective of the performance measure that is applied. This in-sample dominance is not altogether surprising as the portfolios of funds are not subject to the second layer of fees

that trim down fund of fund returns. Unfortunately for fund of fund managers, the out-of-sample performance of the equal-weighted portfolios of hedge funds also clearly dominates the results of the best fund of funds. Independently of the performance metric on which we base our selection criteria, the hedge fund portfolios outperform the fund of funds on all three measures. The strongest results are however obtained by conditioning our portfolio on past Information ratios and restricting our investment to Non-Directional strategies. Overall, these results seem to imply that the extra layer of fees paid to fund of fund managers are largely unmerited, as we can create portfolios of funds, using simple portfolio construction rules and readily available market information, that greatly outperform the best Fund of Funds.

Acknowledgments

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