WHAT IS THE OPTIMAL NUMBER OF MANAGERS IN A FUND OF HEDGE FUNDS?

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Abstract

This paper investigates the level and the determinants of the optimal number of hedge fund managers in a Fund of Hedge Funds (FOFs). The paper also analyzes the impact that this level has on the performance and the volatility of returns of the typical FOF. Several important findings emerge. First, we find that the number of underlying hedge funds (HFs) included into a FOF has a negative and significant impact on the volatility of returns but less of an impact on the actual returns. However, if we properly classify the FOFs into several larger categories of interest, we find evidence that the FOFs having between 6 and 10 hedge fund managers perform the best. On average this group of FOFs has assets under management of around $200 million. Second, further evidence shows that there is a positive relationship between the size of the FOF portfolio and the lifetime of the fund. Third, several factors that influence the number of HF managers into a FOF include, but are not limited to the amount of leverage, the redemption frequency, the size of the fund, the total number of assets managed by the FOF manager, whether the fund issues a K-1 schedule for tax purposes, the currency in which the fund trades, the geographical focus, and the strategy pursued.

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1. Introduction

The explosion of fund of hedge funds (FOFs) over the last ten years has resulted in nearly every financial institution, endowment fund, and pension fund to increase their allocation to alternative investments. FOFs have become a permanent fixture of institutional investor portfolios and provide downside equity risk management. As noted by the high allocation of numerous endowments such as Harvard and Yale over the last 15 years into alternative investments, their returns have exceed the average performance of endowment funds, traditional stock, and bond investment portfolios, as well as major market indexes.

Many institutional investors, having no experience in hedge fund manager selection are willing to pay the additional layer of fees of owning a pre-packaged and diversified FOFs rather than setting up an in-house FOF. The number of underlying hedge fund managers in a FOF can play a primordial role in its performance and its survival. We believe this is the first paper to our knowledge that examines the optimal number of underlying hedge fund managers in FOFs. Numerous papers have stated what the optimal number of hedge fund managers in FOFs should be, but none have used an actual dataset to examine this.

Each FOF manager has a recipe for hedge fund manager selection, as well as the number of optimal hedge fund managers to be added in the FOFs. This important decision may yield outstanding or catastrophic results. The failure of Long Term Capital Management and other noteworthy hedge funds suggests that investors diversify among different hedge fund managers or simply select FOFs as an exposure to hedge funds. Whenever a FOF manager adds or removes a hedge fund manager from the underlying portfolio of hedge funds, the FOF history is not influenced and continues to report net monthly returns (Fung and Hsieh, 2000).

When investing in a FOFs, a track record is very important (Capon et. al 2006) as well as its net performance and volatility in down markets. Intuitively, a larger number of hedge fund managers ina FOFs should reduce the volatility of returns. Do FOFs with few or many underlying hedge fund managers survive longer? Should investors buy FOFs with few or many underlying hedge funds? As there are hundreds of FOFs to select from, the task can be long, arduous, and complex. On the surface, a FOF with 20-30 underlying hedge fund managers would appear to provide sufficient diversification. Statistical theory has given us a relationship between portfolio size and variance. As Park and Staum (1998, p.40) state "…where σ_i^2 is the expected variance of a single randomly selected security, σ_m^2 is the variance of the market portfolio of securities and σ_n^2 is the expected variance of a randomly selected portfolio of n securities, yielding the following equation":

$$\sigma_n^2 = \sigma_m^2 + \frac{(\sigma_i^2 - \sigma_m^2)}{n} \qquad (1)$$

According to equation (1) from Park and Staum (1998; p.40) a fund with 30 managers reduces 96.7 per cent (1-1/n) of the unsystematic variance (naïve diversification); one with 80 managers reduces 98.75 per cent (1-1/n), resulting in an insignificant amount as more hedge fund managers are added to the

FOFs. In addition, Statman (1987) suggests that the added value of diversification drops when more mutual funds are added to an investment portfolio. For example, with 9 to 10 mutual funds, a large portion of the diversification effect is addressed and if more than 10 funds are added there is little to benefit from diversification (Evans and Archer, 1968). Why then do some FOFs contain less than 20 managers and others more than 60, 80 or 100? By having a great many number of hedge fund managers in a FOFs, is it simply to convince potential investors of the safety in numbers? If a FOF manager contains 60, 80 or more underlying hedge fund managers, then managerial skill may likely be diversified away and the FOF will produce average performance. In addition, a large FOF with many underlying hedge fund managers, beyond a certain point may diminish the benefits of diversification.

In this paper we investigate the performance of FOFs during the January 2000-December 2008 period. Our fourfold strategy examines (1) the distribution of both simple and risk-adjusted returns and the difference in performance using difference-in-means tests across classifications and "treatment" variables (2) use bootstrapping to deal with small-sample issues (3) analyze the factors that influence the selection of managers into a FOF and (4) finally examine how the number of underlying hedge fund managers affects a FOFs performance and volatility of returns. We also briefly present new findings regarding the impact the number of HF managers in a FOF has on its survival. Although it is common knowledge that adding more HF managers in a fund will decrease volatility, it may not necessarily increase performance. All our analyses suggest that smaller and more nimble FOFs have the best performance with an asset size of about $200 million. However, as the number of HF managers increases survival also increases. Additionally, we find that highly leveraged FOFs have more underlying HF managers, that FOFs investing in numerous developed markets contain more HF managers, while funds with few HF managers typically have a more confined geographical focus. We obtain these findings by using both the full sample and a smaller sample where we remove the first 12 months of returns to correct for potential biases. It stands to reason that to control for volatility in a FOF it may be best for a potential investor to select a large FOF or vice versa if performance is the key driving force.

The paper is organized as follows. Section 2 reviews the existing literature on FOFs diversification. Section 3 summarizes and analyzes the data using a FOFs classification according to the number of underlying HF managers. Section 4 investigates the factors that determine the optimal level of HFs into a FOF as well as the impact this level has on the FOFs' returns and volatility of returns. Section 5 concludes.

2. Literature Review

The literature is sparse in this area but one study makes an argument that four to five managers is the absolute minimum for a FOFs in order to reduce the diversifiable variance by 80% (Henker, 1998). With a few underlying managers, high percentages must be allocated to each of the underlying hedge funds. The drawback associated with this approach is that if one or two managers have poor performance the entire FOF will suffer. Not only will the FOF be aggressive in its approach, but it will also have a higher volatility than a FOF with a larger number of managers. On average, we can assume that more hedge funds in a FOFs will provide lower volatility along with stable returns, which is the ultimate goal of a FOFs. Downside risk statistics also decrease considerably when more funds are added to a portfolio (O'Neal, 1997). Peskin et al. (2000, p.7) argue that "…as few as 20 hedge fund managers preserve the desirable effects of the hedge fund indexes."

As the number of hedge fund managers is added to a FOFs its performance increases, the standard deviation drops, and the diversification benefits are attained with about 6 managers (Brands and Gallagher, 2005). In Lhabitant and Learned (2002) the authors state that a majority of FOFs have between 15-40 underlying hedge fund managers and anything more would suggest that diversification benefits are decreased[1]. In addition, Kaiser et al. (2008) observe that the performance is superior for large FOFs, which display lower standard deviation than smaller ones. However, Boyson (2008) finds that smaller young funds have the greatest performance persistence. Ammann and Moerth (2008) also confirm this finding. Gregoriou (2003) finds that dead FOFs have the highest volatility in their last month of operation before shutting down and nearly twice as much as twelve months prior and 50% higher than their last six months.

When size is examined in isolation it has no impact on the performance of FOFs (Kaiser et al., 2008). In addition, Amin and Kat (2002) suggest that 20 hedge funds are required to attain optimal diversification. Furthermore, Van Hedge Advisors believes the best number of managers is nine to 10 for a FOF for complete diversification. An extensive telephone survey carried out by Managed Account Reports (MAR) finds that two thirds of the mean number of hedge fund managers of FOFs was between nine and 11. In addition, Gregoriou (2003) finds that large FOFs with assets greater than $200 million have the least number of dead funds, while funds with assets under $50 million have the highest. However, some very successful hedge funds with good track records turn down additional capital because size could have a negative impact on their performance (Gregoriou and Rouah, 2002). Kouwenberg (2003) reveals that hedge fund volatility increases dramatically while monthly performance deteriorates for disappearing funds in the Zurich Capital Markets database during the period 1995-2001. Further, Kouwenberg (2003) shows that the latter display higher volatilities, lower Sharpe ratios and lower mean returns than the surviving funds in the same database. An interesting observation by Gregoriou et al. (2008) is that

[1] The authors have a word they use for the decrease in diversification benefits "diworsification".

offshore FOFs have a higher survival time than onshore funds (8.30 years vs. 7.78). Additionally, Gregoriou (2006) examines the number of live and dead micro FOFs in increments of $5 million and finds that the greatest number of dead funds is for the category with less than $20 million under management, and especially for the $0-$5 million category. The same finding also applies for volatility: volatility increases as we go down the ladder of assets under management.

In the past the literature has documented that FOFs generally underperform the market. However, a few papers suggest that the best FOFs (Fung et al. 2006; Capocci and Hübner, 2006) are the ones that get large amounts of capital inflows. Large sized FOFs appear to be embraced by investors due to the track record as opposed to their small counterparts. When hedge fund managers are ranked by their historical performance and if we examine how many times the hedge fund manager was a winner or a loser, the number is close to 50%, thereby suggesting no performance persistence or managerial skill (Brown, Goetzmann and Ibbotson, 1999; Agarwal and Naik, 2000). One can only wonder whether it is the HF manager's lack of talent or because his strategy is not performing. Therefore, an excessive number of HF managers in a FOF can be counter-productive — there are not that many first-rate hedge fund managers. An early study concluded that nine to ten hedge funds reduces the un-diversifiable risk of a portfolio (Rostron and Colvin, 1999). It is physically difficult, time-consuming and costly to monitor 60 or more hedge funds. Moreover, a larger number requires more quarterly on-site visits with the numerous HF managers to track their performance and scrutinize their strategies. It is common knowledge that the ability to swiftly change the exposure and rapidly get in and out of positions is an advantage only enjoyed by small FOFs (9-10).

3. Data Analysis

We use monthly net returns of all fees supplied by the Barclay Hedge database from January 2000 until December 2008. The Barclay hedge fund database is the only database that has the number of underlying hedge fund managers in FOFs as a field. Although a longer period would be desirable, the database does not report information on the dead funds prior to January 2000. Thus, to eliminate the potential problems associated with the inherent survivorship bias we choose to ignore the period prior to 2000. Moreover, as Fung and Hsieh (2000) suggest, our hedge fund data may suffer from other biases as well. For instance, voluntary inclusion in the database may lead to sample selection problems. The Barclay database will accept any hedge fund that is currently trading regardless of how long it has been trading. The only requirement is that the hedge fund must provide its performance since inception. If a fund stops reporting for 3 months it is transferred into the dead fund category. However, if the fund starts resending its returns the fund will be reactivated in the live database. Given that the more successful funds have more incentives to list and attract investors our data may also display a backfill bias. To alleviate these problems, we repeat the estimations after we eliminate the first 12 months of returns data from each fund (similar to Teo (2009).

We have information on 3,285 FOFs out of which 90 are closed to new investors, 1,792 are open, 962 have been delisted (either because the manager has asked to be removed from the database or because the FOF manager stops updating his fund's performance for 3 months), and 441 have been liquidated. In our analysis, we treat the liquidated funds as dead funds, and the rest as live ones. Our variable of interest is the number of underlying hedge fund managers in a FOF. For ease of presentation, we divide the FOFs in 13 categories: 0 to 5 underlying HF managers, 6-10, 11-15, 16-20, 21-30, 31-40 and all the way in increments of 10 until 91-100. We bundle all the FOFs with more than 100 underlying HFs into one final category. We believe this classification summarizes the data well and provides a relevant structure to investors and interested practitioners.

3.1. Descriptive Summary

Panels A, B and C in Table 1 provide some descriptive statistics of our data. Panel A displays information concerning the number of underlying managers and the average simple return, according to whether the FOFs are alive/dead and located outside/inside US, respectively.

[Insert Table 1 approximately here]

Among the live funds, FOFs with up to 30 managers comprise 70% of all live funds. Similarly, among the dead funds 85% have up to 30 managers. Further, FOFs with more than 100 underlying HFs represent 3% and 6% among live and dead funds, respectively. For the live funds, the 91-100 category displays the highest mean at 0.11% monthly average return. However, we have only 7 funds in this category and this may pose a problem. The second best performing category is the one with 21-30 funds at 0.09%. Among the dead funds, if we ignore the categories with only one observation (i.e., 81-90 and 61-70) we see that FOFs with 0-5 and 6-10 managers display the highest returns, at 0.21 and 0.28%, respectively. Throughout, we use a simple difference-in-means test to test whether the average of the "treatment" group is different from that of the "control" group:

$$Diff - in - means\ Test = \frac{E(X_t) - E(X_c)}{\sqrt{\frac{s_t^2}{N_t} + \frac{s_c^2}{N_c}}} \qquad (2)$$

where, $E(X_i)$, s_i, and N_i, $i=t,c$ represent the average, standard error, and sample size of the "treated" and "control" groups, respectively. According to the central limit theorem, the test follows a standard normal distribution provided that the sample size is large. Generally, this condition is met for funds with fewer underlying HF managers, but not always for funds with more managers in the portfolio (e.g., 60 or more). Thus, the results from the test are to be interpreted with great care in those cases. For robustness purposes subsection 3.4 repeats the tests after we perform 5000 bootstrap simulations to ensure an approximate standard normal distribution.

Thus, a simple difference-in-means test across the different categories for the live and dead funds respectively, shows that only for the 6-10 category are the average returns significantly different from each other. For the rest we can conclude that whether a fund is categorized as live and dead does not lead to any systematic statistical difference across our intervals of interest.

Further, Panel A displays some interesting information concerning the number and average return for FOFs for offshore and onshore funds. First, one can note that in our sample 86% of the funds are domiciled outside the U.S. (especially in the Cayman Islands and the British Virgin Islands). Second, most of the offshore FOFs appear to perform much worse than the domestic ones. Thus, out of the 13 categories for the FOFs inside the U.S., only 2 (the 51-60 and above 100 categories) display negative average returns. However, among the FOFs located outside the U.S., 7 categories experience negative monthly returns. Overall, a series of difference-in-means tests indicate that the simple average returns are significantly different from each other across funds from outside and inside US, respectively.

Panel B summarizes the number and the average monthly returns across all categories according to the stated geographical focus of the FOF. Most of the funds appear to follow a global market strategy (73%). However, the performance of this strategy appears to be mixed: roughly half of the categories display negative returns, while the other half displays positive ones, albeit small. At 0.09%, the 16-20 category has the highest return. However, sharp conclusions characterize the FOFs that follow a narrower geographical focus. For example, FOFs that invest only in Latin America and Eastern Europe respectively, display negative returns for all the categories for which data is available. On the contrary, FOFs that focus on North America registered positive monthly returns for all the 7 categories for which data is available. Next, FOFs that focus on Western Europe and Pacific Rim/Asia also appear to display good returns. At 0.57%, the 0-5 category for Western Europe has the highest average monthly return among all the categories and geographical regions considered in Panel B.

Finally, Panel C summarizes the returns for each category according to the strategy pursued. In our dataset, around half of the FOFs state that they follow either a diversified or an arbitrage strategy, while the other half does not state a specific strategy. Although the overall performance appears mixed, it seems that FOFs with at least up to 60 underlying managers and that follow a diversified or an arbitrage strategy experience lower volatilities than FOFs without a stated one. A series of difference-in-means tests suggests that the performances of diversified and arbitrage FOFs are statistically different from each other at the 5% level in only 2 cases. However, it appears that in most cases the returns of FOFs with a stated strategy are statistically different from those of FOFs without a stated one.

3.2. Methodology

In order to better understand the FOFs performance with respect to the number of underlying managers we perform several investigations. First, we consider the distribution of assets under management (abbreviated AUM) across the 13 categories. Second, we consider the distribution of returns according to whether the funds are listed or not. Third, we also look at their survival times. Next, we compare and contrast the simple return with a risk-adjusted performance measure. Simple difference-in-means tests are performed to test whether the results are statistically different across the 13 categories. However, as the sample size may not be sufficiently large for some classifications, we repeat the tests after we perform 5,000 bootstrap replications. Further, to alleviate any concerns due to the backfilling bias, we repeat the tests after we drop the first 12 months of data for each fund. Lastly, in section 4 we perform several regressions to analyze the factors that influence the selection of managers into a FOF and also investigate how the number of underlying managers affects the fund's performance and volatility of returns.

3.3 Results

Table 2 outlays the average size according to the AUM and further compares and contrasts the simple monthly return with a risk-adjusted monthly performance.

[Insert Table 2 approximately here]

The 61-70 interval displays the highest average size at roughly $1.5 bln, while the 11-15 interval has the smallest size at almost $80 mln. However, there does not appear to be a positive or a negative relationship between the average size and the number of underlying HF managers according to our classification. Overall, the risk adjusted return appears to be higher than the simple return. Nevertheless, the two measures are significantly different from each other at the 5% level in only 4 intervals: 6-10, 11-15, 31-40, and 61-70. Among these four, the 6-10 interval has the highest risk-adjusted performance at 0.09%. Table 2 also reports information on the skewness and kurtosis of simple returns. We see that returns are negatively skewed across all classifications. Also, the kurtosis suggests that the simple returns are non-normal. However, as the number of underlying HF managers increases, both the skewness and excess kurtosis become smaller suggesting that HF diversification leads to more Gaussian-like behavior.

Table 3 investigates the survival times and the differences in average returns depending on whether a fund is publicly listed or not.

[Insert Table 3 approximately here]

The results indicate that having 91-100 underlying hedge fund managers leads to the longest average survival time of 64 months. However, according to the median the longest survival intervals are the 71-80 and the 100+ ones at 59 and 57 months, respectively. These are followed closely by the 31-40 interval with 56

months. Given that there are 83 FOFs with 100+ managers and only 10 with 71-80 one feels more confident with selecting the 100+ category if one desires a longer survival time. Interestingly, FOFs containing 91-100 and 100+ managers have a lower standard deviation than all other intervals at 16 and 17 months, respectively. A possible explanation is that it may be difficult to get in and out of position when there are 90+ in the FOFs as opposed to say 31-40. An interesting finding is that FOFs with the shortest survival time according to both the mean and the median contain 81-90 managers. Nevertheless, a simple regression line through both the mean and the median survival time against the number of underlying HF managers slopes positively upwards. Figure 1 shows the results. Therefore, we may conclude that the FOFs survival increases with the number of underlying hedge fund managers.

Table 3 further investigates the distribution of returns across our intervals of interest depending on whether a FOF is publicly listed or not. The large majority of FOFs are not listed (70.4%). It appears that in only 3 cases are the average returns significantly different from each other at the 5% level: 11-15, 61-70, and 81-90. Therefore, it seems that whether a fund is or is not listed on an exchange does not crucially affect a fund's overall performance (at least according to our own interval classifications). Still, among the publicly listed funds the 41-50 interval registers the highest monthly return at 0.21%[2], while among the non-listed FOFs the best performing interval is the 21-30 at 0.09%.

3.4. Bootstrap Results

In order to refine the precision of the standard error estimates employed in the tests above, we perform a set of 5000 bootstrap simulations where we re-estimate the average values of the lifetime, simple, and risk-adjusted return measures. In all replications we ensure that the same number of observations are drawn from each interval as in the original sample and that the repeated samples are obtained with replacement.

[Insert Table 4 approximately here]

Table 4 displays the results. The point estimates up to the second decimal are roughly the same as above. However, the 95% confidence intervals are much tighter and the standard error estimates much smaller than in Tables 2 and 3. A series of difference –in-means tests (not reported due to space limitations) shows now that for each interval classification the simple and risk-adjusted returns are significantly different from each other. Further, the above conclusion where the lifetime appears to slope upwards as the number of underlying hedge fund increases is preserved.

However, the bootstrap simulations rely on the critical assumption that FOFs select and/or leave the sample randomly. As we argued above, this assumption may be violated because of the backfilling bias and the self-selection of the more successful funds. Thus, the simple returns and/or risk-adjusted returns may be

[2] We choose to ignore the 91-100 interval with only one observation, and the 71-80 interval for the not-listed funds where there are only 2 observations.

biased upwards. Therefore, we repeat the tests after we eliminate the first 12 months of observations for each fund. Finally, we bootstrap this new set of returns in order to refine the standard error estimates.

3.5 Results without the first 12 months of data

Table 5 contains the results on the shorter sample. Because some FOFs have a history of less than 12 months implies that almost for all intervals we have fewer observations in Table 5 than in Table 2. As the intuition suggests, the simple returns in Table 5 appear smaller than those in Table 2 in all but one instance – the 71-80 interval.

[Insert Table 5 approximately here]

The amount of bias varies from 15 basis points in the case of interval 91-100 to 90 basis points for the 61-70 one. A difference-in-means test confirms that this upward bias is significant at the 5% level for 8 intervals (i.e., 0-5, 11-15, 21-30, 31-40, 41-50, 61-70, 81-90, 100+) and at the 10% level for 2 more (i.e., 6-10 and 16-20). Comparing the risk-adjusted returns across the two samples (i.e., Tables 2 and 5), we find evidence that the bias is less pronounced. Thus, the difference is statistically significant at the 5% level in only 5 instances (i.e., 0-5, 11-15, 21-30, 41-50, and 61-70) and at the 10% level in one instance (i.e., 81-90). The amount of upward bias varies from 7 basis points to 19 basis points. If one directly compares the simple with the risk-adjusted return for the restricted sample, one can note that the two are statistically significant from each other at the 5% level in 10 instances. We cannot reject the null of equality at the 10% level for the rest of the intervals: 51-60, 71-80, and 91-100.

Further, we perform bootstrap simulations to refine the standard error estimates. The last two columns in Table 5 show the results both for the simple and risk-adjusted performance measures. The tests statistics are significant at the 5% level for all categories and for both performance measures. Therefore, the evidence indicates that the elimination of the first 12 months of data leads to more reliable estimates, at least for the simple average monthly return. Figures 2 and 3 plot the graphs of the bootstrapped simple and risk adjusted returns for the original and the modified samples, respectively. A visual inspection of the graphs suggests that the risk adjusted returns are less dispersed for both samples. Also, it appears that correcting for the volatility of returns reduces the impact of the negative observations, such that the risk-adjusted returns are generally higher than the simple ones.

Further, a quick inspection of the restricted sample shows that the highest risk-adjusted return is obtained for the 6-10 interval. This highlights once again the result that emerged for the original sample. As before, using the simple average return we see that the 71-80 interval has the only positive monthly return. However, having only 9 observations for this group may not be sufficient to draw a strong conclusion. A possible explanation for the average negative returns on the restricted sample across all classifications may lie with the ending date of our sample (December 2008) when the Great Recession was still in full swing.

Nevertheless, based on the results in both Tables 2 and 5 we cautiously conclude that the 6-10 interval provides the highest return for an investor considering a FOF.

Next, we want to investigate what factors determine the optimal number of HF managers into a FOF and whether this number affects the magnitude and volatility of FOF returns.

4. OLS Results

Table 6 shows the results of the first OLS regression where the dependent variable is the number of underlying HF managers. We have full information on 1671 FOFs. Throughout we use robust standard errors and cluster using the manager ID variable to take care of the cross-correlation among FOFs managed by the same manager (i.e., we have a total of 333 different managers). To formalize the discussion, let *y* denote the dependent variable, *X* the set of explanatory variables, *k* the number of parameters, and *N* the number of observations. The variance of the simple OLS β estimator would write:

$$\sigma_{\beta}^{2} = E\left[(X'X)^{-1}X'\big(y - E(y)\big)\big(y - E(y)\big)'X(X'X)^{-1}\right], \quad (3)$$

where all the off-diagonal elements are zero and those on the diagonal are identical. Instead we assume that the diagonal terms are not identical and the off-diagonal terms are not zero unless they come from different clusters. Letting *W* denote the cross-correlation matrix for the within-cluster observations we have:

$$\sigma_{\beta}^{2} = E\left[(X'WX)^{-1}X'W\big(y - E(y)\big)\big(y - E(y)\big)'WX(X'WX)^{-1}\right], \quad (4)$$

We let *W* be estimated from the data. We further use an extensive set of control variables.

Structured product is a dummy variable indicating whether a FOF is registered as a structured product or not. Only 4.64% of the funds are registered as such. *Startups* indicates if the FOFs invests in start-up companies with limited track record (15.10% are doing so). *Domicile* is 1 for onshore and 0 for offshore funds. *Master Feeder* specifies whether a fund is structured as a master portfolio to which smaller funds contribute. Only 2% of the funds in our sample are organized as master feeders. *AUM* is expressed in natural logarithm. *Reporting style* indicates whether a fund reports its gross or net of all fees performance. *Management and performance fees* are expressed in percentages. *High-water Mark* is an indicator variable referring to FOFs manager duty to recoup any losses before being paid performance fees. The large majority of the funds (78%) have such a provision. *Leverage* indicates the amount of fund's leverage in percentage terms. Because FOFs are taxed as partnerships, the investor will report their gains and losses from the hedge fund investment to the IRS via a Schedule K-1. Thus, having a K1 form issued may lower the tax liabilities for investors who experience financial losses. Around 15% of the FOFs in our sample use such a form. *Investment Min*, as the name suggests, is the logarithm of the dollar amount used as the initial investment. *Lockup period* refers to the number of days the investor has to keep his investment with the fund until he is allowed to make the first withdrawal. *Subscription and redemption frequency* are coded from 1 to 8 and denote

an increase in the frequency from annual to daily (e.g., annual, semi-annual, quarterly, monthly, bi-monthly, weekly, bi-weekly, and daily). The *Notice Period* refers to the redemption period and is measured in days. *AUD, CAD, CHF, DKK, EUR, GBP, JPY, NOK, SEK, USD, and ZAR* indicate whether the FOFs trade in the respective national currencies. Because of the fewer observations available and their smaller representation we lump together the *BRL, ISK, INR, NZD, SGD, and TWD* national currencies as *Other Small Currencies*. We set the *USD* as the benchmark variable. Most of the funds trade in US dollars (55%) followed by Euro (26%), British pound (8%), and Japanese Yen (2%). *Exchange Listing* is a dummy showing whether a FOF is publicly listed or not. *Closed, Open, Delisted, and Liquidated* indicates the status of the FOF. We set *Liquidated* as the benchmark indicator. *Manager AUM* is the log of dollar amount of how much money the FOF manager is trading - this is obtained by summing the *AUM* for all funds a manager has. *Manager Country* is 1 if the manager resides in US and 0 elsewhere. In total 27.38% of the managers reside in US. *Exchange Listing* indicates whether a fund is publicly listed or not. The next set of dummy variables indicates the broader geographical focus. The *Global Markets* approach is set as the benchmark. Generally, the funds pursue either a diversified (51%) or arbitrage (5.44%) investment strategy. The rest have not adopted a specific strategy. We set the latter as the benchmark variable. The Hurdle Rate is 1 if the FOF has one (30%) and 0 if not (70%). A FOF may receive funds from three types of investors: US only (12%), non US only (58%), or both (30%). We set the latter as the benchmark.

[Insert Table 6 approximately here]

Several conclusions emerge. First, whether a FOF features as a structured product, invests in startup companies, resides offshore or onshore, or is a master feeder does not appear to have any effect on the number of HF managers selected. A 1% increase in the AUM appears to increase the optimal number of managers by at least 1. We further conclude that the fee structure, the amount of the initial investment, the lockup period, and the subscription frequency do not significantly affect the number of HFs in the portfolio. However, if a fund has a high-water mark provision appears to increase this number by at least 6 managers in the portfolio. Thus, it seems that this provision decreases the appetite for risk of the FOF manager. Also, the increase in the amount of leverage by 1 percentage point causes an increase of the underlying portfolio of HFs by 7 more managers. A K1 form, if issued, also has a negative significant impact by reducing this number by more than 10 managers. Intuitively, being issued a K1 form leads to a higher ability to recover losses and reduces the investor's tax burden. This in turn may increase the appetite for risk which may be reflected through a lower size of the portfolio. As the redemption frequency increases, it appears that the number of HFs in the portfolio increases by 3 managers. This intuitively makes sense, as a higher frequency should potentially decrease the downside risk that can be amplified by a higher redemption frequency especially in down markets. A higher number of employees has a small but still significant negative impact. Next, the nature of the trading currency appears to have a major impact relative to the US dollar. Thus, FOFs trading in *AUD, CAD, CHF, EUR,* and

GBP appear to have more managers than the ones trading in USD. This may indicate a more prudent behavior as possibly being generated by a desire to insulate against currency movements. Interestingly, funds trading in the Danish kroner and South African rand appear to have a lower optimal number by as much as 40 and 7 managers, respectively. As found in the previous section, whether a fund is listed on an exchange and its status do not appear to have a significant impact. Interestingly, the total wealth that the FOF manager manages appears to have an impact twice as large as the one the overall size of the fund has. Thus, the manager's decision to diversify is influenced more by the total *AUM* he manages than the particular *AUM* he disposes for a single fund. Next, relative to the *Global Market* strategy, focusing on certain geographical regions is associated with less diversification and thus a lower number of HFs in the portfolio. As one would expect, if a fund follows a diversified approach to investing translates into a higher number of managers (11 more HF managers) relative to our benchmark of no specific category. The existence of a hurdle rate does not seem to have a major impact on our dependent variable. Finally, funds that accept only U.S. investors tend to be more diversified than those that also accept non-U.S. investors by as much as 21 more managers in the portfolio. This model is able to explain around 21% of the variation in the number of underlying hedge fund managers.

Next, we want to investigate the effect that our variable of interest has on the overall FOFs returns and volatility of returns. To avoid any possible complications due to the backfilling and sample selection issues we limit our analysis to the restricted sample where we eliminate the first 12 months of data from each fund.

Table 7 reports the regression of the simple average return on our variable of interest using a set of control variables. In addition to the variables in Table 6, we include the lifetime of each FOF. We have a total of 1578 observations grouped in 316 clusters and an R^2 of 42%.

[Insert Table 7 approximately here]

Unfortunately, it doesn't appear that the number of underlying HF managers has any statistically significant impact on the overall fund performance. Although they are not of immediate interest to our current analysis, we note that the longer the fund has been in existence the higher its return, and that the higher the leverage the lower the return. In addition, funds that focus on Eastern Europe, Latin America, MENA, and Asian countries generally experience lower returns than those that follow a Global Market approach. Noting that there could be potential feedback effects from our dependent variable to the *Lifetime* variable that may cause potential endogeneity issues, we repeat the regression without the latter. The sign and the significance of the other explanatory variables do not appear to be affected and therefore we conclude that our results are robust to misspecification. For space limitations we omit this regression. We also perform another regression where we bootstrap the standard errors in order to check our inference. However, using 100 simulations we observe that the statistical significance from Table 7 is preserved. Again, we omit this set of results due to

space limitations[3].

Next we want to check whether the number of underlying manager has any impact on the volatility of returns. Table 8 reports the results. Again the coefficient on the number of underlying managers does not appear to be significant and we note some interesting facts.

[Insert Table 8 approximately here]

As intuition suggests, funds that follow a diversified approach, trade in Euros and Japanese Yen, are larger in size and have been around longer experience lower volatility. In contrast, highly leveraged funds and funds where the FOF manager is responsible for a higher total level of *AUM* display higher volatility. Similarly, funds that focus on Eastern Europe, Latin America, and Middle East and North Africa (MENA) countries display higher volatility than those that follow a Global Market approach. Note that our model explains around 47% on the variation of FOFs volatility of returns.

Finally, recognizing that volatility is a highly persistent process we re-estimate the model in Table 9 where in addition to the previous set of control variables we include past volatility information up to a 6 month lag.

[Insert Table 9 approximately here]

We model past volatility in the following way: the average volatility from the beginning of the sample up to the sixth, fifth, fourth, third, second, and last month prior to the last observation in the sample are computed, respectively. Thus we may write:

$$s_k = \frac{1}{T-k-1}\sum_{t=1}^{T-k}(R_{it} - \bar{R}_i)^2 \, , k = 1,2, \dots 6, \qquad (5)$$

where *T* denotes the last observed month for fund *i*.

We see that the R^2 increases to 98.6%, implying that past information of the volatility explains around 52% of its present variation. Surprisingly, in the presence of past volatility, the number of underlying HFs in the portfolio has a negative and statistically significant impact at the 5% level. Thus, the inclusion of one more HF manager in the portfolio appears to reduce the returns volatility by 0.03 basis points.

We want to investigate whether this result also holds true for the full sample. Thus we repeat the estimation of the model in Table 9 for the full sample. Table 10 provides the results.

[Insert Table 10 approximately here]

Indeed, it appears that the finding above is also a feature of the full sample: the addition of one more HF in the portfolio lowers the volatility by 0.03 basis points. The sign and significance of the other control variables is preserved.

[3] The results are available upon request from the authors.

5. Conclusion

The findings of this paper indicate that the number of underlying HFs included into a FOF has a negative and significant impact on the volatility of returns but less of an impact on the actual returns. However, if we properly classify the FOFs into several intervals of interest we find evidence that the FOFs that have in between 6 and 10 HF managers perform the best. On average, this group of FOFs has assets under management of around $200 mln. This conclusion emerges when we employ both the original sample and a restricted one where we eliminate the first 12 months of data to correct for potential self-selection issues and other biases.

As intuition suggests, further evidence shows that the lifetime of a fund increases with a higher number of managers. We also find that a fund's larger *AUM* and a higher level of AUM managed by the FOF manager lead to more diversified portfolios of HFs. Also, highly leveraged funds seem to have a higher number of underlying HFs. The existence of a highwater mark provision appears to encourage a more prudent behavior that leads to portfolio diversification. On the same lines, a higher redemption frequency is associated with a larger FOF portfolio as it may lead to a more risk-averse behavior. In contrast, being issued a K1 form encourages more risk-loving behavior and less HFs in the portfolio. Generally, the currency in which a FOF trades seems to be important for the size of the FOF portfolio. Thus, FOFs that trade in the Australian and Canadian dollar, Swiss franc, British pound and the Euro contain more underlying HFs relative to funds that trade in the US dollar. Further, funds that have a narrower geographical focus tend to have a smaller portfolio of HFs relative to funds with a global market perspective. Similarly, FOFs with a stated diversified strategy have larger portfolios than those without a stated one. Finally, funds that target only US investors appear to have a bigger size portfolio of HFs relative to funds that cater both US and Non US investors.

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Tables and Figures

Table 1: Summary Statistics

The sample period is from January 2000 to December 2008. The FOFs are grouped in 13 broad categories according to the number of underlying hedge fund managers in the portfolio. The dead funds have been liquidated, while the live funds can be open or closed to new investors, or still active but delisted. Onshore funds are located inside US, while offshore funds are located outside US. Standard deviations are shown in parenthesis; ***Significance at the 1% level, ** Significance at the 5% level, *Significance at the 1% level.

Panel A: by Status (Dead/Live) and Location

	Dead		Live		Test	Location outside US		Location in US		Test
Managers	N	Mean (Std.Dev)	N	Mean (Std. Dev)	Diff in Means	N	Mean (Std. Dev)	N	Mean (Std. Dev)	Diff in Means
0 to 5	45	0.21 (0.78)	249	0 (0.95)	-1.41	262	0.02 (0.95)	32	0.1 (0.68)	0.60
6 to 10	35	0.28 (0.57)	192	-0.13 (1.03)	-3.04***	183	-0.15 (0.97)	44	0.27 (1.02)	2.48**
11 to 15	34	-0.08 (0.99)	263	-0.22 (1.05)	-0.69	248	-0.27 (1.05)	49	0.10 (0.96)	2.43**
16 to 20	42	-0.06 (1.09)	295	0.01 (0.87)	0.37	268	-0.07 (0.94)	69	0.30 (0.69)	3.67***
21 to 30	47	0.03 (0.59)	411	0.09 (0.71)	0.51	381	0.05 (0.75)	77	0.24 (0.33)	3.56***
31 to 40	17	-0.06 (0.58)	251	-0.1 (1.06)	-0.27	248	-0.13 (1.06)	20	0.30 (0.55)	3.07***
41 to 50	1	0.14 (.)	140	0.07 (0.68)	.	129	0.04 (0.69)	12	0.37 (0.46)	2.20**
51 to 60	.	.	44	-0.11 (0.76)	.	37	-0.11 (0.80)	7	-0.16 (0.59)	-0.19
61 to 70	1	0.67 (.)	51	-0.59 (1.13)	.	50	-0.59 (1.14)	2	0.20 (0.52)	2.00**
71 to 80	.	.	10	0.06 (0.72)	.	10	0.06 (0.72)	.	.	.
81 to 90	1	0.69 (.)	22	-0.25 (0.70)	.	23	-0.21 (0.71)	.	.	.
91 to 100	.	.	7	0.11 (0.22)	.	6	0.07 (0.21)	1	0.34 (.)	.
100+	15	-0.19 (0.64)	68	-0.01 (0.49)	0.84	77	0 (0.50)	6	-0.48 (0.65)	-1.76*

Panel B: by Geographical Focus

	Global Markets		P Rim/Asia		N. America		W. Europe		E. Europe		Lat America	
Managers	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
0 to 5	192	-0.02 (0.78)	16	0.06 (0.47)	26	0.4 (0.52)	10	0.57(0.28)	1	-6.47 (.)		
6 to 10	145	0.03 (0.97)	20	-0.01 (0.52)	15	0.18 (0.30)	2	0.42(0.29)	2	-3.77 (0.63)	2	-0.80 (0.28)
11 to 15	179	-0.16 (1.15)	25	-0.23 (0.86)	15	0.02 (0.40)	6	0.18(0.13)	3	-2.44 (0.66)	3	-0.50 (0.85)
16 to 20	201	0.09 (0.84)	28	0.19 (0.62)	11	0.28 (0.31)	12	-0.17(0.68)			6	-0.87 (1.01)
21 to 30	358	0.07 (0.74)	14	0.09 (0.53)	9	0.23 (0.21)	1	0.40 (.)				
31 to 40	234	-0.11 (1.07)	3	0.46 (0.27)	1	0.46 (.)						
41 to 50	124	0.07 (0.70)			1	0.37(.)	1	0.55 (.)				
51 to 60	39	-0.09 (0.78)										
61 to 70	50	-0.56 (1.16)										
71 to 80	10	0.06 (0.72)										
81 to 90	17	0.08 (0.52)										
91 to 100	6	0.07 (0.21)										
100+	79	-0.06 (0.52)										

Panel C: by Strategy

Managers	Diversified		Arbitrage		N/A		Diff-in-Means		
	N	Mean	N	Mean	N	Mean	Div. Vs Arbitrage	Div. Vs N/A	Arbitrage vs N/A
0 to 5	116	-0.07 (0.81)	18	-0.20 (0.77)	156	0.12 (1.01)	-0.67	1.77*	-1.64
6 to 10	95	0.08 (0.72)	4	0.29 (0.35)	126	-0.20 (1.15)	1.10	-2.23**	2.43**
11 to 15	119	-0.07 (0.77)	12	0.08 (0.82)	166	-0.32 (1.21)	0.62	-2.14**	1.58
16 to 20	135	0.11 (0.65)	10	0.13 (0.22)	192	-0.08 (1.06)	0.18	-2.00**	1.97**
21 to 30	251	0.11 (0.64)	25	-0.01 (0.35)	182	0.06 (0.80)	-1.30	-0.62	-0.67
31 to 40	182	-0.05 (1.04)	28	0.04 (0.68)	58	-0.30 (1.13)	0.60	-1.49	1.73*
41 to 50	89	0.19 (0.66)	12	-0.27 (0.22)	39	-0.10 (0.74)	-4.83***	-2.09**	-1.24
51 to 60	33	-0.20 (0.86)	1	0.12 (.)	10	0.14 (0.22)	.	2.04**	
61 to 70	13	-0.47 (1.56)	12	-1.73 (0.820	27	-0.09 (0.50)	-2.54**	0.86	-6.39***
71 to 80	10	0.06 (0.72)							
81 to 90	13	0.05 (0.64)			10	-0.54 (0.68)		-2.12**	
91 to 100	6	0.07 (0.21)			1	0.34 (.)			
100+	71	-0.09 (0.53)			12	0.30 (0.25)		4.11***	

Table 2: Fund classification by AUM (USD), Performance (Simple Returns), and Risk Adjusted Performance

Skewness and kurtosis are reported for the simple mean return. We use the sample standard deviation to adjust for risk. The Difference-in-Means test compares the simple mean return with the risk-adjusted mean return for each grouping. Standard deviations are shown in parenthesis; ***Significance at the 1% level, ** Significance at the 5% level, *Significance at the 1% level.

	AUM		Performance				Risk Adj. Performance		Diff-in-Means
Managers	N	Mean	N	Mean	Skewness	Kurtosis	N	Mean	Test
0 to 5	261	$116,441,199	294	0.03 (0.93)	-1.47	11.40	293	0.14 (1.00)	-1.30
6 to 10	208	$203,634,686	227	-0.07 (0.99)	-1.74	4.05	226	0.09 (0.37)	-2.25**
11 to 15	274	$79,560,841	297	-0.21 (1.05)	-2.23	5.84	297	0.02 (0.38)	-3.42***
16 to 20	312	$104,987,788	337	0.01 (0.90)	-3.12	15.53	337	0.11 (0.48)	-1.81*
21 to 30	427	$223,720,659	458	0.08 (0.70)	-2.12	12.87	458	0.10 (0.28)	-0.52
31 to 40	237	$411,640,286	268	-0.1 (1.03)	-3.76	20.84	265	0.08 (0.30)	-2.68**
41 to 50	132	$294,881,868	141	0.07 (0.68)	-0.64	6.42	141	0.08 (0.27)	-0.13
51 to 60	44	$226,904,796	44	-0.11 (0.76)	-2.72	8.16	44	0.01 (0.20)	-1.07
61 to 70	52	$1,523,177,901	52	-0.56 (1.13)	-0.58	0.37	52	-0.07 (0.34)	-2.99***
71 to 80	10	$233,759,327	10	0.06 (0.72)	-2.98	9.13	10	0.08 (0.28)	-0.10
81 to 90	16	$164,998,786	23	-0.21 (0.71)	-0.38	-0.55	23	-0.06 (0.21)	-1.01
91 to 100	7	$152,726,825	7	0.11 (0.22)	-0.73	-0.57	7	0.06 (0.09)	0.51
100+	82	$288,407,805	83	-0.04 (0.52)	-0.80	0.14	83	0.05 (0.20)	-1.38

Table 3: Fund classification by Lifetime and Exchange Listing

Lifetime is measured in months. The Difference-in-Means test compares the simple mean return across exchange listed and non-listed funds. Standard deviations are shown in parenthesis; ***Significance at the 1% level, ** Significance at the 5% level, *Significance at the 1% level.

	Lifetime			Exchange Listed		Exchange Not Listed		Diff
Managers	N	Mean	Median	N	Mean	N	Mean	In Means
0 to 5	294	50.4 (25.24)	52	72	-0.05(0.79)	222	0.06 (0.97)	-0.92
6 to 10	227	43.38 (25.65)	42	47	-0.3 (1.00)	180	-0.01 (0.98)	-1.75*
11 to 15	297	45.35 (26.90)	38	80	-0.43 (1.20)	217	-0.12 (0.97)	-2.04**
16 to 20	337	49.72 (27.48)	50	120	0.03 (0.80)	217	-0.01 (0.95)	0.38
21 to 30	458	51.65 (24.70)	51.5	127	0.07 (0.81)	331	0.09 (0.65)	-0.20
31 to 40	268	55.62 (25.46)	56	87	-0.14 (1.02)	181	-0.07 (1.04)	-0.52
41 to 50	141	51.84 (24.02)	52	30	0.21 (0.73)	111	0.03 (0.66)	1.23
51 to 60	44	50.36 (23.47)	52.5	19	-0.35 (1.04)	25	0.06 (0.39)	-1.62
61 to 70	52	47.5 (30.26)	34	35	-0.89 (1.13)	17	0.11 (0.82)	-3.60***
71 to 80	10	60.8 (29.07)	59	8	0 (0.80)	2	0.3 (0.10)	-1.02
81 to 90	23	38.61 (20.31)	36	13	0.06 (0.49)	10	-0.57 (0.81)	2.16**
91 to 100	7	64.14 (16.13)	55	1	0.24 (.)	6	0.09 (0.23)	NA
100+	83	53.65 (17.19)	57	24	-0.08 (0.40)	59	-0.02 (0.56)	-0.56

Table 4: Bootstrap returns, risk adjusted returns and lifetime

5000 replications are employed to refine the standard error estimates. The simulations are performed with replacement while keeping the original sample sizes for each category intact.

	Performance		Risk Adj. Performance	Lifetime
Managers	N	Mean (Std. Dev)	Mean (Std. Dev.)	Mean (Std. Dev)
0 to 5	5000	0.03 (0.05)	0.13 (0.06)	50.43 (1.49)
6 to 10	5000	-0.07 (0.07)	0.09 (0.02)	43.35 (1.70)
11 to 15	5000	-0.21 (0.06)	0.01 (0.02)	45.38 (1.54)
16 to 20	5000	0.01 (0.05)	0.11 (0.03)	49.73 (1.34)
21 to 30	5000	0.08 (0.03)	0.1 (0.01)	51.63 (1.14)
31 to 40	5000	-0.09 (0.06)	0.08 (0.02)	55.62 (1.55)
41 to 50	5000	0.07 (0.06)	0.08 (0.02)	51.86 (2.02)
51 to 60	5000	-0.11 (0.11)	0.01 (0.03)	50.79 (3.59)
61 to 70	5000	-0.56 (0.16)	-0.07 (0.05)	47.52 (4.16)
71 to 80	5000	0.05 (0.23)	0.08 (0.09)	60.59 (9.31)
81 to 90	5000	-0.21 (0.15)	-0.05 (0.04)	38.54 (4.20)
91 to 100	4996	0.11 (0.08)	0.06 (0.04)	64.05 (6.24)
100+	5000	-0.04 (0.06)	0.05 (0.02)	53.65 (1.87)

Table 5: Fund classification using a smaller sample to adjust for backfill bias

The first 12 months of observations are eliminated for each fund. 5000 bootstrap replications with replacement are employed to refine the standard error estimates.

	Performance			Risk Adj. Performance			Bootstrap Ret		Bootstrap Adj. Ret
Managers	N	Mean	Median	N	Mean	Median	N	Mean (Std. Dev)	Mean (Std. Dev)
0 to 5	274	-0.36 (1.42)	0.07	271	-0.05 (0.56)	0.03	5000	-0.36 (0.09)	-0.05 (0.03)
6 to 10	202	-0.29 (1.56)	0.09	198	0.53 (5.07)	0.04	5000	-0.29 (0.11)	0.53 (0.35)
11 to 15	272	-0.54 (1.66)	-0.03	264	-0.07 (0.43)	-0.01	5000	-0.54 (0.10)	-0.07 (0.03)
16 to 20	311	-0.14 (1.14)	0.16	307	0.08 (0.50)	0.08	5000	-0.14 (0.06)	0.08 (0.03)
21 to 30	438	-0.2 (1.16)	0.1	435	0.01 (0.38)	0.04	5000	-0.2 (0.05)	0.006 (0.02)
31 to 40	255	-0.33 (1.38)	0.14	255	0.05 (0.59)	0.06	5000	-0.34 (0.09)	0.05 (0.04)
41 to 50	132	-0.19 (1.06)	0.11	131	0.01 (0.30)	0.05	5000	-0.19 (0.09)	0.01 (0.03)
51 to 60	40	-0.28 (0.99)	0	40	-0.05 (0.24)	0	5000	-0.28 (0.14)	-0.05 (0.04)
61 to 70	52	-1.47 (2.17)	-0.56	51	-0.26 (0.44)	-0.2	5000	-1.47 (0.31)	-0.26 (0.06)
71 to 80	9	0.16 (0.30)	0.27	9	0.11 (0.15)	0.17	4998	0.16 (0.10)	0.11 (0.05)
81 to 90	21	-0.81 (1.21)	-0.66	21	-0.20 (0.32)	-0.25	5000	-0.8 (0.26)	-0.2 (0.07)
91 to 100	7	-0.04 (0.26)	-0.07	7	0.01 (0.11)	-0.03	4996	-0.04 (0.10)	0.01 (0.04)
100+	83	-0.34 (0.98)	-0.15	83	-0.01 (0.31)	-0.05	5000	-0.34 (0.11)	-0.01 (0.03)

Table 6: OLS - Dependent variable: Number of underlying hedge funds

White heteroskedasticity consistent and cross-correlation robust standard errors are employed. We correct for the cross-correlation of residuals by clustering using the manager unique ID variable. The independent variables are among others *Structured Product*, *Startups* (1 if the FOFs invest in start-up companies with limited track record), *Domicile* (1 for onshore funds), *Master Feeder* (1 for funds structured as master portfolios to which smaller funds contribute), *Reporting Style* (1 if the fund reports net of all fees), *Highwater Mark* (1 for FOFs with such provision), *K1* (1 for FOFs that issue a K-1 schedule under the US Tax code), currency control variables, fund status variables, geographical focus, strategy, and investor type variables. We set *USD*, *Global Market* focus, a *non-stated strategy* and *Investor type: both US and non US* variables as the benchmark indicator variables.

Variable	*Coefficient*	*(Robust Std. Error)*	*Variable*	*Coefficient*	*(Robust Std. Error)*
Structured Product	-10.073	(6.453)	Exchange Listing	-2.408	(4.679)
Startups	-12.880	(11.993)	Closed	-3.612	(6.223)
Domicile	-1.355	(5.738)	Open	5.703	(3.506)
Master Feeder	-3.738	(4.374)	Delisted	2.403	(4.911)
AUM (% USD)	1.532*	(0.838)	Manager AUM	3.071**	(1.395)
Reporting Style	10.109	(13.066)	Manager Country	-2.536	(4.284)
Management Fee	-2.081	(3.723)	Eastern Europe Only	-9.750***	(3.515)
Performance Fee	-0.245	(0.279)	East Eur Based	0.329	(6.383)
Highwater Mark	6.867**	(3.218)	Latin America	-3.730	(3.840)
Leverage	7.533**	(3.070)	MENA	-9.866**	(4.395)
K1	-10.826**	(4.832)	North America Only	-8.965***	(2.600)
Investment Min	1.437	(1.412)	North America Based	-6.814***	(2.634)
Lockup period	-0.007	(0.009)	Asia Only	-11.961***	(3.349)
Subscription Freq.	-3.162	(2.502)	Asia Based	-11.897*	(6.791)
Redemption Freq.	3.082*	(1.799)	Western Europe Only	-16.838***	(4.053)
Notice Period	-0.028	(0.043)	West Europe Based	1.776	(10.104)
No. Of Employees	-0.010**	(0.004)	Other Geographical Reg.	-11.252*	(5.773)
AUD	17.092**	(5.754)	FOF strategy: Diversified	11.132***	(2.620)
CAD	23.094**	(9.989)	FOF strategy: Arbitrage	7.092	(4.564)
CHF	7.362**	(3.277)	Hurdle Rate	5.073	(3.358)
DKK	-39.825***	(12.533)	Investor Type: US	21.763**	(8.898)
EUR	2.184*	(1.308)	Investor Type: Non US	1.537	(3.674)
GBP	4.346*	(2.473)	Intercept	-106.909***	(30.851)
JPY	0.387	(5.890)			
NOK	8.546	(7.841)			
SEK	-7.597	(7.387)			
ZAR	-16.164***	(4.962)			
Other Small Currencies	5.861	(4.933)			
N	1671;	Number of clusters (Manager ID) = 333			
R-squared	0.2091				
Significance levels: * : 10%; ** : 5%; *** : 1%					

Table 7: OLS - Dependent variable: Mean Return (Backfill bias adjusted sample)

White heteroskedasticity consistent and cross-correlation robust standard errors are employed. We correct for the cross-correlation of residuals by clustering using the manager unique ID variable. The independent variables are among others *Structured Product*, *Startups* (1 if the FOFs invest in start-up companies with limited track record), *Domicile* (1 for onshore funds), *Master Feeder* (1 for funds structured as master portfolios to which smaller funds contribute), *Reporting Style* (1 if the fund reports net of all fees), *Highwater Mark* (1 for FOFs with such provision), *K1* (1 for FOFs that issue a K-1 schedule under the US Tax code), currency control variables, fund status variables, geographical focus, strategy, and investor type variables. We set *USD*, *Global Market* focus, a *non-stated strategy* and *Investor type: both US and non US* variables as the benchmark indicator variables.

Variable	*Coefficient*	*(Robust Std. Error)*	*Variable*	*Coefficient*	*(Robust Std. Error)*
Structured Product	-0.328	(0.203)	Exchange Listing	-0.072	(0.097)
Startups	0.250**	(0.106)	Closed	-0.587***	(0.150)
Domicile	0.013	(0.190)	Open	-0.562***	(0.126)
Master Feeder	-0.504	(0.464)	Delisted	0.055	(0.192)
AUM (% USD)	0.076***	(0.028)	Manager AUM	-0.064**	(0.026)
Reporting Style	-0.004	(0.502)	Manager Country	0.132	(0.121)
Management Fee	0.107	(0.092)	Eastern Europe Only	-6.691***	(0.179)
Performance Fee	0.014	(0.010)	East Eur Based	-0.230	(0.150)
Highwater Mark	-0.087	(0.112)	Latin America	-1.214*	(0.647)
Leverage	-0.246**	(0.120)	MENA	-1.569***	(0.142)
K1	0.176	(0.190)	North America Only	-0.165	(0.149)
Investment Min	-0.004	(0.019)	North America Based	-0.046	(0.127)
Lockup period	-0.001	(0.001)	Asia Only	0.220	(0.138)
Subscription Freq.	-0.002	(0.072)	Asia Based	-1.369*	(0.787)
Redemption Freq.	0.013	(0.058)	Western Europe Only	-0.065	(0.229)
Notice Period	-0.003*	(0.001)	West Europe Based	-0.290	(0.996)
No. Of Employees	-0.0002**	(0.000)	Other Geographical Reg.	-0.254	(0.185)
AUD	-0.228	(0.157)	FOF strategy: Diversified	0.060	(0.086)
CAD	-0.402	(0.363)	FOF strategy: Arbitrage	-0.587**	(0.264)
CHF	-0.212**	(0.099)	Hurdle Rate	-0.071	(0.085)
DKK	0.057	(0.181)	Investor Type: US	-0.136	(0.167)
EUR	-0.142**	(0.062)	Investor Type: Non US	0.020	(0.109)
GBP	-0.005	(0.083)	Number of underlying HFs	0.001	(0.001)
JPY	-0.381**	(0.179)	Lifetime	0.025***	(0.002)
NOK	0.164	(0.230)	Intercept	-0.887	(0.809)
SEK	-0.455	(0.421)			
ZAR	0.427***	(0.125)			
Other Small Currencies	-0.001	(0.171)			
N	1578;	Number of clusters (Manager ID) = 316			
R-squared	0.4234				
Significance levels: * : 10%; ** : 5%; *** : 1%					

Table 8: OLS - Dependent variable: Volatility of Returns (Backfill bias adjusted sample)

White heteroskedasticity consistent and cross-correlation robust standard errors are employed. We correct for the cross-correlation of residuals by clustering using the manager unique ID variable. The independent variables are among others *Structured Product*, *Startups* (1 if the FOFs invest in start-up companies with limited track record), *Domicile* (1 for onshore funds), *Master Feeder* (1 for funds structured as master portfolios to which smaller funds contribute), *Reporting Style* (1 if the fund reports net of all fees), *Highwater Mark* (1 for FOFs with such provision), *K1* (1 for FOFs that issue a K-1 schedule under the US Tax code), currency control variables, fund status variables, geographical focus, strategy, and investor type variables. We set *USD*, *Global Market* focus, a *non-stated strategy* and *Investor type: both US and non US* variables as the benchmark indicator variables.

Variable	*Coefficient*	*(Robust Std. Error)*	*Variable*	*Coefficient*	*(Robust Std. Error)*
Structured Product	0.406	(0.327)	Exchange Listing	0.111	(0.158)
Startups	-0.258	(0.169)	Closed	1.405***	(0.268)
Domicile	0.202	(0.203)	Open	1.052***	(0.219)
Master Feeder	-0.088	(0.444)	Delisted	0.237	(0.263)
AUM (% USD)	-0.087**	(0.034)	Manager AUM	0.077**	(0.038)
Reporting Style	-0.294	(0.399)	Manager Country	-0.168	(0.136)
Management Fee	0.209*	(0.108)	Eastern Europe Only	11.612***	(0.444)
Performance Fee	-0.001	(0.019)	East Eur Based	1.221**	(0.571)
Highwater Mark	-0.104	(0.141)	Latin America	2.703*	(1.470)
Leverage	1.333***	(0.184)	MENA	5.338***	(0.372)
K1	0.026	(0.227)	North America Only	0.036	(0.213)
Investment Min	0.012	(0.028)	North America Based	0.027	(0.133)
Lockup period	0.001	(0.001)	Asia Only	0.288	(0.427)
Subscription Freq.	0.005	(0.080)	Asia Based	0.806	(0.547)
Redemption Freq.	-0.072	(0.055)	Western Europe Only	0.113	(0.413)
Notice Period	-0.001	(0.002)	West Europe Based	-0.237	(0.753)
No. Of Employees	0.000	(0.000)	Other Geographical Reg.	-0.310	(0.431)
AUD	0.939***	(0.183)	FOF strategy: Diversified	-0.176*	(0.105)
CAD	0.029	(0.221)	FOF strategy: Arbitrage	0.037	(0.167)
CHF	-0.190	(0.143)	Hurdle Rate	0.082	(0.092)
DKK	-0.235	(0.194)	Investor Type: US	-0.215	(0.189)
EUR	-0.204**	(0.102)	Investor Type: Non US	0.155	(0.150)
GBP	-0.277*	(0.148)	Number of underlying HFs	-0.001	(0.001)
JPY	-0.493***	(0.177)	Lifetime	-0.019***	(0.002)
NOK	0.264	(0.354)	Intercept	1.484	(0.981)
SEK	0.494	(0.609)			
ZAR	-0.513**	(0.218)			
Other Small Currencies	0.173	(0.207)			
N	1562;	Number of clusters (Manager ID) = 313			
R-squared	0.4690				
Significance levels: * : 10%; ** : 5%; *** : 1%					

Table 9: OLS - Dependent variable: Volatility (Augmented Form) – short sample

We augment the previous model with information on past volatility: the average volatility from the beginning of the sample up to the sixth, fifth, fourth, third, second and last month are considered. White heteroskedasticity consistent and cross-correlation robust standard errors are employed. We correct for the cross-correlation of residuals by clustering using the manager unique ID variable. The independent variables are among others *Structured Product*, *Startups* (1 if the FOFs invest in start-up companies with limited track record), *Domicile* (1 for onshore funds), *Master Feeder* (1 for funds structured as master portfolios to which smaller funds contribute), *Reporting Style* (1 if the fund reports net of all fees), *Highwater Mark* (1 for FOFs with such provision), *K1* (1 for FOFs that issue a K-1 schedule under the US Tax code), currency control variables, fund status variables, geographical focus, strategy, and investor type variables. We set *USD*, *Global Market* focus, a *non-stated strategy* and *Investor type: both US and non US* variables as the benchmark indicator variables.

Variable	*Coefficient*	*(Robust Std. Error)*	*Variable*	*Coefficient*	*(Robust Std. Error)*
Structured Product	-0.034	(0.032)	Open	-0.056*	(0.029)
Startups	-0.005	(0.011)	Delisted	0.069	(0.063)
Domicile	0.003	(0.022)	Manager AUM	0.007*	(0.004)
Master Feeder	-0.018	(0.030)	Manager Country	-0.010	(0.022)
AUM (% USD)	-0.002	(0.003)	Eastern Europe Only	-0.577*	(0.335)
Reporting Style	-0.066	(0.041)	East Eur Based	-0.014	(0.023)
Management Fee	-0.006	(0.010)	Latin America	2.703*	(1.470)
Performance Fee	0.002	(0.002)	MENA	-0.115	(0.124)
Highwater Mark	-0.021	(0.020)	North America Only	-0.023	(0.019)
Leverage	0.047***	(0.017)	North America Based	0.007	(0.026)
K1	0.027	(0.026)	Asia Only	-0.020	(0.014)
Investment Min	0.001	(0.003)	Asia Based	-0.109**	(0.042)
Lockup period	-0.0001**	(0.000)	Western Europe Only	-0.023*	(0.012)
Subscription Freq.	0.005	(0.014)	West Europe Based	-0.115	(0.090)
Redemption Freq.	-0.006	(0.013)	Other Geographical Reg.	-0.027	(0.024)
Notice Period	-0.001	(0.001)	FOF strategy: Diversified	0.011	(0.009)
No. Of Employees	0.000	(0.000)	FOF strategy: Arbitrage	0.028	(0.033)
AUD	0.662*	(0.412)	Hurdle Rate	0.017	(0.012)
CAD	-0.023	(0.021)	Investor Type: US	-0.052*	(0.027)
CHF	-0.018	(0.012)	Investor Type: Non US	-0.020	(0.021)
DKK	-0.002	(0.022)	Number of underlying HFs	-0.0003**	(0.0001)
EUR	0.010	(0.010)	Lifetime	0.0002	(0.0002)
GBP	0.003	(0.013)	Volatility (1 Lag)	1.162***	(0.096)
JPY	-0.034**	(0.015)	Volatility (2 Lags)	-0.194	(0.125)
NOK	-0.022	(0.037)	Volatility (3 Lags)	0.055	(0.069)
SEK	-0.010	(0.018)	Volatility (4 Lags)	-0.021	(0.062)
ZAR	-0.004	(0.021)	Volatility (5 Lags)	-0.053	(0.036)
Other Small Currencies	0.140***	(0.028)	Volatility (6 Lags)	0.032	((0.033)
Exchange Listing	-0.0003	(0.015)	Intercept	1.484	(0.981)
Closed	-0.068	(0.066)			
N	1477;	Number of clusters (Manager ID) = 308			
R-squared	0.9864				
Significance levels: * : 10%; ** : 5%; *** : 1%					

Table 10: OLS - Dependent variable: Volatility (Augmented Form) – full sample

We augment the previous model with information on past volatility: the average volatility from the beginning of the sample up to the sixth, fifth, fourth, third, second and last month are considered. White heteroskedasticity consistent and cross-correlation robust standard errors are employed. We correct for the cross-correlation of residuals by clustering using the manager unique ID variable. The independent variables are among others *Structured Product*, *Startups* (1 if the FOFs invest in start-up companies with limited track record), *Domicile* (1 for onshore funds), *Master Feeder* (1 for funds structured as master portfolios to which smaller funds contribute), *Reporting Style* (1 if the fund reports net of all fees), *Highwater Mark* (1 for FOFs with such provision), *K1* (1 for FOFs that issue a K-1 schedule under the US Tax code), currency control variables, fund status variables, geographical focus, strategy, and investor type variables. We set *USD*, *Global Market* focus, a *non-stated strategy* and *Investor type: both US and non US* variables as the benchmark indicator variables.

Variable	*Coefficient*	*(Robust Std. Error)*	*Variable*	*Coefficient*	*(Robust Std. Error)*
Structured Product	-0.019	(0.026)	Open	-0.046*	(0.023)
Startups	-0.004	(0.008)	Delisted	0.058	(0.052)
Domicile	0.006	(0.016)	Manager AUM	0.007*	(0.004)
Master Feeder	-0.026	(0.022)	Manager Country	-0.010	(0.019)
AUM (% USD)	-0.002	(0.003)	Eastern Europe Only	-0.336	(0.248)
Reporting Style	-0.058*	(0.032)	East Eur Based	-0.007	(0.018)
Management Fee	-0.004	(0.009)	Latin America	-0.059*	(0.035)
Performance Fee	0.001	(0.001)	MENA	-0.011	(0.083)
Highwater Mark	-0.017	(0.016)	North America Only	-0.021	(0.015)
Leverage	0.043***	(0.015)	North America Based	0.007	(0.021)
K1	0.018	(0.018)	Asia Only	-0.011	(0.009)
Investment Min	0.001	(0.002)	Asia Based	-0.046**	(0.020)
Lockup period	-0.0001**	(0.000)	Western Europe Only	-0.010	(0.009)
Subscription Freq.	0.005	(0.012)	West Europe Based	-0.079	(0.065)
Redemption Freq.	-0.007	(0.011)	Other Geographical Reg.	-0.010	(0.026)
Notice Period	-0.001	(0.001)	FOF strategy: Diversified	0.007	(0.008)
No. Of Employees	0.000	(0.000)	FOF strategy: Arbitrage	0.008	(0.033)
AUD	0.527*	(0.332)	Hurdle Rate	0.014	(0.009)
CAD	-0.023	(0.020)	Investor Type: US	-0.036*	(0.020)
CHF	-0.016	(0.009)	Investor Type: Non US	-0.009	(0.015)
DKK	-0.021	(0.016)	Number of underlying HFs	-0.0003**	(0.0001)
EUR	0.007	(0.007)	Lifetime	0.0002	(0.0002)
GBP	0.004	(0.008)	Volatility (1 Lag)	1.244***	(0.109)
JPY	-0.026*	(0.014)	Volatility (2 Lags)	-0.277**	(0.134)
NOK	-0.018	(0.022)	Volatility (3 Lags)	0.085	(0.071)
SEK	0.001	(0.015)	Volatility (4 Lags)	-0.101	(0.086)
ZAR	-0.008	(0.015)	Volatility (5 Lags)	0.043	(0.042)
Other Small Currencies	0.082***	(0.029)	Volatility (6 Lags)	-0.010	((0.014)
Exchange Listing	-0.009	(0.011)	Intercept	-0.017	(0.076)
Closed	-0.056	(0.053)			
N	1500;	Number of clusters (Manager ID) = 308			
R-squared	0.9878				
Significance levels: * : 10%; ** : 5%; *** : 1%					

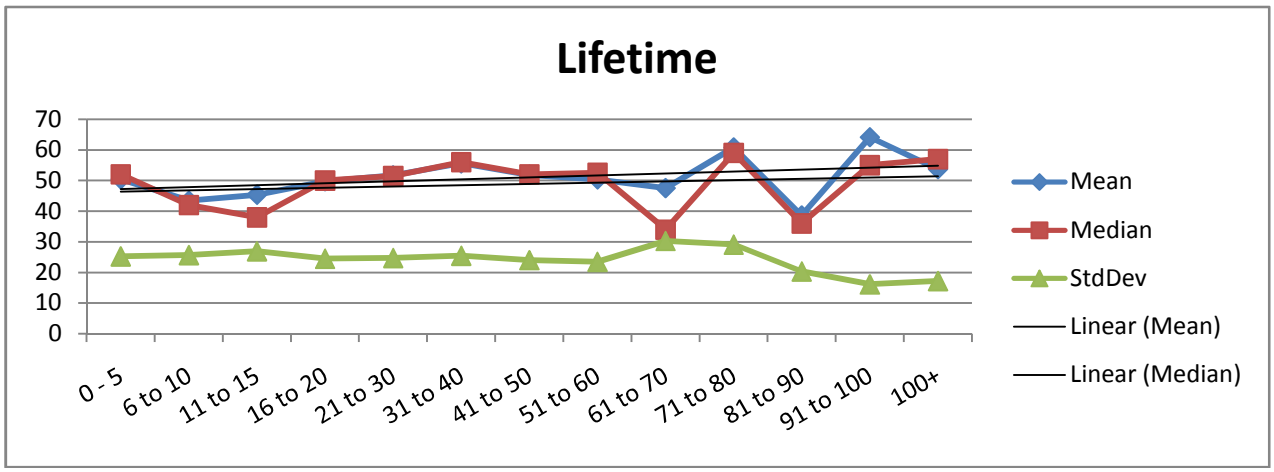

Figure 1: FOFs lifetime across the 13 intervals

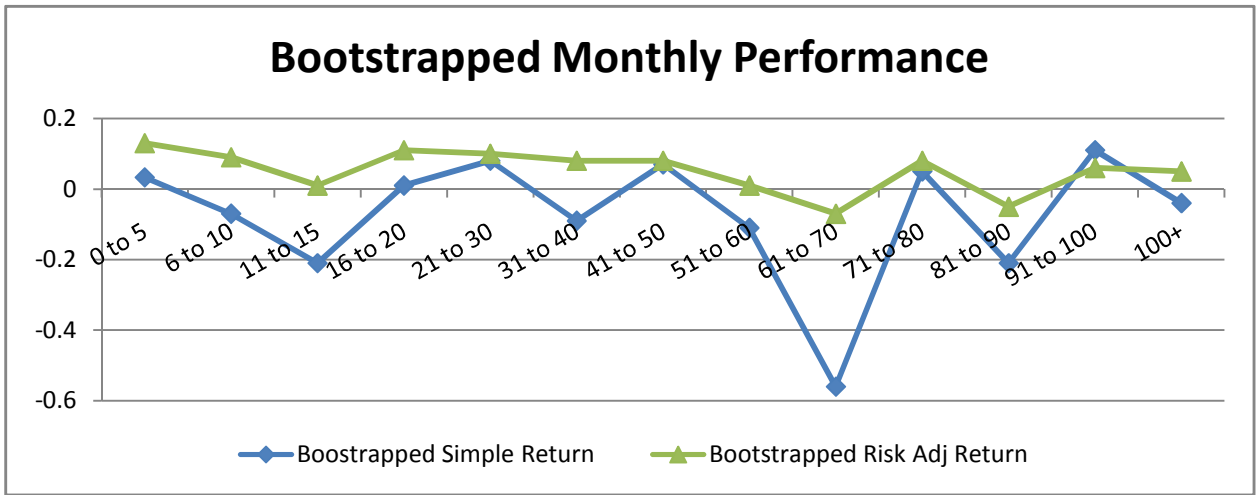

Figure 2: FOFs returns after 5000 bootstrap simulations

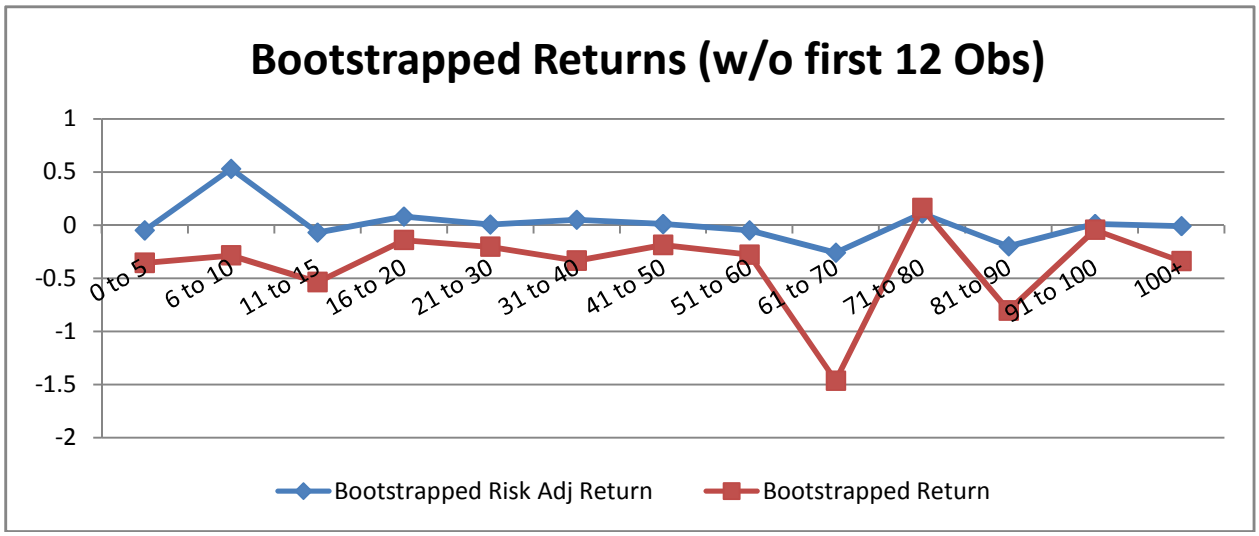

Figure 3: FOFs returns after 5000 bootstrap simulations for the short sample