Style Shifts and Diversification in Funds of Funds

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Abstract

In this paper we aim to uncover the drivers of shifts in style exposures of funds of funds and find out if funds of funds manage to diversify away style-specific risk. We investigate whether past performance of hedge fund styles and risk factors inherent in hedge funds and also due diligence quality of hedge funds have an impact on style mix decisions of funds of funds. We quantify the due diligence quality by the recognition score we introduce. Our results show that funds of funds pay note to the past performance of both risk factors and style performances and tend to increase their exposure to the styles that have better due diligence. When it comes to style diversification, we find that funds of funds showed satisfactory performance and that this performance has been persistent.

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1 Introduction

Despite their increasing popularity among individual and institutional investors, funds of funds have so far found place in the hedge funds literature mainly as one of the hedge fund styles. However, due to distinctions in structure and the variety of asset classes to invest, they have a different status and hence deserve individual attention. For instance, funds of funds have different fee structures than hedge funds (Brown, Goetzmann and Liang, 2004) and invest only in hedge funds whereas hedge funds can hold virtually any asset class in their portfolios. Moreover, Liang (2004) points out that including funds of funds in the sample while performing analyses on hedge funds will create a double counting problem. Although there are a couple of papers that handle funds of funds individually (Brown, Goetzmann and Liang, 2004 and Liang, 2004 are two examples), to our knowledge none has addressed the question of how funds of funds form their investment strategies. In this paper we aim to take a step towards filling this gap in the current literature by providing insight about the style mix of funds of funds. More specifically, we hope to find out the drivers of the changes in style exposures of fund of funds portfolios, and assess whether funds of funds provide sufficient style diversification. We find that prior performances of risk factors inherent in hedge funds and hedge fund styles, as well as the average due diligence quality of hedge fund styles are effective in determining the direction and magnitude of the shifts of the style exposures of funds of funds. We also observe that funds of funds outperform a benchmark index portfolio, and that this superior performance is persistent. Apart from taking a step towards unveiling investment strategies of funds of funds, we make another important conribution to the literature with this paper by introducing a measure for due diligence quality of hedge funds.

According to Fung and Hsieh (1998), a hedge fund's style is determined by the asset class mix in its portfolio, the directional exposure to these asset

classes and the level of leverage employed by the fund manager. Therefore, the hedge funds that adopt the same style, having similar assets in their portfolios and positions in these assets, should be expected to show similar risk and return characteristics. Indeed, Brown and Goetzmann (2003) document that differences in investment style of hedge funds contribute about one fifth of cross-sectional variability in performance. In line with this, Fung and Hsieh (2004) state that funds within a style are exposed to common risk factors, and that the set of risk factors and exposures vary across styles. Since the return characteristics as well as the common risk factors inherent in pure hedge fund styles evolve over time, the style composition of fund of funds portfolios should be expected to be time-variant as well. We estimate the style exposures of funds of funds through a Sharpe style regression (Sharpe, 1988, 1992), for a two-year-long time window, and roll the window forward by one month at a time to capture the movements in style exposures.

Berk and Green (2004) make the key assumption that investors learn about fund manager's ability by looking at past risk-adjusted returns and shift their wealth toward better performing funds. Indeed, Fung, Hsieh, Naik and Ramadorai (2008) document trend-chasing behavior in capital flows for a major subgroup of hedge funds. Fung and Hsieh (2001) also observe trend-following behavior in hedge funds. Following these, we try to find out if funds of funds base their style exposure decisions on past performances, or exhibit trend following behavior to change the style mix of their portfolios. We investigate the effects of past performance of styles as well as the changes in the eight risk factors[1] defined in Fung and Hsieh (2004) on changes in style exposures of funds of funds.

Recent hedge funds literature points out that operational risk plays a major part in hedge fund failure and due diligence serves to reduce the op-

[1]Fung and Hsieh (2004) originally define seven risk factors; however, recently they added an eighth factor, which they call emerging market risk factor, as announced on David Hsieh's website at http://faculty.fuqua.duke.edu/∼dah7/HFRFData.htm

erational risk, increasing the survival probability (See Brown, Fraser and Liang, 2008, or Brown et al 2008a and 2008b for instance). Based on these findings, we examine if the style shifts in fund of funds portfolios are related to due diligence. One challenge in this analysis is that there is no commonly accepted measure for due diligence that we can use in our analysis. Following Brown, Fraser and Liang (2008), we construct recognition scores for the service provider companies (administrators, auditors, custodians, legal counsels and prime brokers) hedge funds work with, and use the recognition score as a proxy for due diligence. The recognition score we construct rests on the number of funds that get service from a company: the more funds the company serves, the more recognizable the company is, which signals a higher quality of due diligence of the funds that receive services from the company.

To find out if prior performances and due diligence play a part in style shifts in fund of funds portfolios, we regress the exposures we estimate for each time window on the performances of risk factors and styles and also the prior due diligence scores of styles, which we calculate as the average of due diligence scores of all funds that belong to the style[2].

As a consequence of having similar exposures to common risk factors, hedge funds that adopt the same style carry style-specific risk. As the exposures and set of risk factors are different among styles, this style-specific risk can be reasonably expected to be diversified away in the portfolio of a fund of funds. However reasonable this may sound, there is no agreement in the current hedge funds literature on whether style diversification opportunities for funds of funds exist. Ackermann, McEnally and Ravenscraft (1999) indicate

[2]By previous year we mean for the twelve month period before the first month of each time window. Similarly, previous window means the 24-month period before the starting month of each time window. For instance, if the exposures were estimated for a time window between January 1996 and December 1997, for the regression with previous year's returns we use the performance and due diligence scores for January-December 1995, and for the one with previous window's returns we use the values of regressors for the period January 1994-December 1995.

that the added diversification in funds of funds serves to lower their volatility. Brown and Goetzmann (2003) provide a supporting view by stating that funds of funds allow investors to hold a diversified portfolio of hedge funds and hence spreading their exposure across a spread of investment strategies. In line with this, Amenc and Martellini (2002) document low and negative correlations between hedge fund style indexes and point out the potential benefits of style diversification. Liang (2004), on the other hand, states an alternative view and argues that funds of funds offer diversification, but not at style level, since different hedge fund styles are highly correlated especially in downmarkets and diversification is not viable. In a nutshell, the current literature focuses on the possibility of style diversification in fund of funds portfolios, rather than investigating its existence. We address this issue and try to find out whether funds of funds diversify away style-specific risk in their portfolios. We expect the results of this analysis to have important implications in investment decisions, since the results can be interpreted as an indicator of whether fund of fund managers take excessive style-specific risk.

To perform our analyses we use a data set provided by TASS Management Limited, covering the period from January 1992 to June 2004. We estimate the style exposures starting from January 1994 to obtain more accurate results, since TASS started to include dead funds in their data base in 1994. We download the data on risk factors from their respective online resources (e.g. U.S. Treasury website for the treasury bill and bond yields and spread, Wilshire Associates website to calculate size factor [small cap minus large cap firms], David Hsieh's web page for the trend following risk factors).

The contribution of this paper is two folds: first, we will shed light, if only partially, on the investment strategies of funds of funds by providing insight into how they change their style mixes. Our second contribution is to the newly flourishing literature on operational risk and due diligence, as

we (approximately) quantify the due diligence quality of hedge funds by the recognition scores of the service provider companies.

The rest of the paper is organized as follows: in the following section we summarize the data we used for our analyses. We explain how we construct the variables in our analysis in the third section. Section four summarizes the analysis methods, followed by the results of the analyses and their interpretations in section five. Finally, section six concludes the paper.

2 Data

For the analyses in this paper we use a hedge fund data set provided by TASS, covering the period between January 1992 and June 2004. We use the style information provided in the data directly instead of classifying the funds into the nine styles defined by TASS manually[3]. We drop 164 funds (110 live and 54 dead) for which primary style information was not available, and 26 others (seven live and nineteen dead) because they report on a quarterly basis. After eliminating duplicates, our data set comprises of 4875 hedge funds and funds of funds, of which 2998 were live and 1877 dead at the end of the sampling period.

Table 1 reports the number of live and dead[4] funds in each style. The sample includes 1109 funds of funds, of which 807 were live and 302 dead as of June 2004. Since we are interested in the differences between live and dead funds of funds, we perform our analyses on the subsamples of live and dead

[3] Although there are various methods to classify funds into styles (see Brown and Goetzmann, 1997, Fung and Hsieh, 1998 or Baquero, Ter Horst and Verbeek, 2005), using the style information in the data base is not an uncommon procedure. Brown, Goetzmann and Ibbotson (1999), Amenc and Martellini (2002) are two examples in which authors use styles reported in the data.

[4] By live funds we mean those funds that were still reporting at the end of sample period, and by dead those that stopped reporting before the sample period was over.

funds of funds, as well as the entire sample. Long/short equity hedge funds form the largest group among pure hedge funds with 1578 funds in total, followed by a wide margin by managed futures, which include 541 live and dead funds in total. Funds that adopt dedicated short bias style constitute the smallest group with only 33 funds. Summary statistics of the funds in the data set presented in Table 2 reveals dedicated short bias funds on average had the lowest return (0.20% per month) and Sharpe ratio (Sharpe, 1966, 1994) of 0.02 among all hedge fund styles. Long/short equity hedge funds yielded the highest return (1.37% per month). However, they also had a considerably high standard deviation of 5.01%, which explains why they rank fifth among hedge fund styles when it comes to average Sharpe ratios, with an average return-to-standard deviation ratio of 0.29. Fixed income arbitrage funds had the highest average Sharpe ratio (0.78) among the nine hedge fund styles. A comparison of live and dead funds shows that on average live funds yielded higher rates of return (1.27% versus 0.73% of dead funds) and had more than two and a half times the Sharpe ratio of dead funds of funds. Table 2 also demonstrates that on average funds of funds yielded lower returns than hedge funds (the average rate of return of hedge funds was 1.27%, whereas funds of funds on average yielded only 0.7% per month). In fact, the average rate of return of funds of funds was even lower than average rate of return of dead funds. However, one should also notice that funds of funds outperformed hedge funds on a risk adjusted basis, as the average Sharpe ratios of funds of funds was 0.39, while hedge funds on average provided a Sharpe ratio of 0.32.

Figure 1 depicts the evolution of number of hedge funds and funds of funds throughout the sample period. The number of hedge funds has steadily increased to reach more than seven times its initial value in January 1992 at the end of sample period. The growth in the number of funds of funds was even faster: the group of funds of funds was almost nine times as populated in June 2004 as it was in June 1992.

We use the eight risk factors[5] defined by Fung and Hsieh (2004) to explain style shifts in funds of hedge funds. There are two equity-oriented factors: equity market factor and the size spread factor defined by Fama and French (1993). We download the S&P500 monthly returns from Datastream and use as the equity market factor. The difference between monthly returns of Wilshire Small Cap 750 index and monthly return of Wilshire Large Cap 1750 indices (both downlowadable at Wilshire Associates website[6]) is the size spread factor. Two bond-oriented risk factors are the bond market factor and the credit spread factor. The monthly change in 10-year treasury constant maturity yield is the bond market factor and the monthly change in the difference between Moody's Baa yield[7] and 10-year treasury constant maturity yield is the credit spread factor. We download the data for both from the Board of Directors of the Federal Reserve System website[8]. Apart from the equity and bond-oriented risk factors there are three trend following factors defined in Fung and Hsieh (2001). These are bond, currency and commodity trend following factors, and data is available at David A. Hsieh's personal website[9]. The last risk factor is the emerging market factor, which was recently added to the model in Fung and Hsieh (2004). We download the monthly MSCI Emerging Market Index from Datastream, and use the monthly returns as the emerging market risk factor.

[5]The risk factors are also listed on David A. Hsieh's hedge fund data library page at http://faculty.fuqua.duke.edu/∼dah7/HFRFData.htm

[6]http://www.wilshire.com

[7]Both 10-year treasury constant maturity yield and Moody's Baa yield data are available for download at the Board of Governors of the Federal Reserve System website at http://federalreserve.gov/releases/h15/data.htm

[8]http://federalreserve.gov/releases/h15/data.htm

[9]http://faculty.fuqua.duke.edu/∼dah7/DataLibrary/TF-FAC.xls

3 Preliminary Analysis

Our primary interest is in finding out how the style exposures of funds of funds evolve. Since, given the number of funds of funds, it is virtually impossible to observe the exposures of each fund of funds individually, not to mention such an exercise will most probably be of little use to draw general conclusions, we estimate the style exposures of a representative fund of funds. The representative fund of funds invests in a portfolio of hedge fund styles, and changes its portfolio weights over time. We create a value-weighted index of all funds of funds in the data set and treat it as the representative fund of funds, then estimate a series of style exposures for it using a moving time window and base our analyses on these exposures.

This time series of style exposures constitutes the dependent variable in our analyses. In the next step we examine whether previous performances of styles, the risk factors inherent in hedge funds and due diligence of hedge funds are a driving force behind the changes in the exposures. Because a conventional measure of due diligence. does not exist yet, following Brown, Fraser and Liang (2008), we construct a due diligence score based on the recognition of service provider companies hedge funds work with. One issue with this approach is the data about the service provider companies are static, i.e. each fund reports the companies and what services they receive from them only once, so the data lacks the time dimension. We fix this by finding out which funds in each style are alive in each time window, then calculate the average due diligence score of styles for the window based on the individual scores of live funds that belong to the style.

3.1 Style Exposures

As the style exposures of funds of funds will be the basis of our analyses, we first need to estimate the exposures before moving on to further analysis.

We first construct a value-weighted index of each hedge fund style as follows:

$$R_{i,t} = \frac{\sum_{j \in i} R_{j,t} * NAV_{j,t}}{\sum_{j \in i} NAV_{j,t}} \tag{1}$$

where

$R_{i,t}$:The index return of style i for month t

$R_{j,t}$:Rate of return of fund j that belongs to style i for month t

$NAV_{j,t}$:Net asset value of fund j in month t.

More explicitly, we weigh the reported rate of return of each hedge fund (j) by its net asset value for the same month (t), then take the summation over the entire set of funds that belong to the same style (i) and divide by the total net asset value of all funds that adopt the same style for the same month[10]. We then construct an index of funds of funds in the same fashion, as the representative fund of funds,.for the entire sample also and subsamples of live and dead funds of funds.

As the next step, we estimate the style exposures of funds of funds through a Sharpe style regression (Sharpe, 1988, 1992), with the fund of funds index as our dependent variable and hedge fund style indexes as our independent variables:

[10]To check for consistency, we plot the constructed indices together with Credit Suisse/Tremont Hedge Fund indices and observe they trace the Tremont indices closely, with the exception of equity market neutral and global macro styles. These plots are available from the corresponding author upon request. The discrepancies can be attributed to the fact that funds need to satisfy certain criteria to be included in the Tremont indices, while we include the funds in the indices as long as they report. Since funds of funds invest in individual funds, which may or may not be included in the indexes but are available to investors, the Tremont indices may not be sufficiently informative to estimate portfolio exposures of funds of funds to hedge fund styles. By using hand-constructed indices instead, our aim is to cover a larger set of pure hedge funds and in turn obtain more accurate results.

$$
\begin{aligned}
R_{FoF,t} &= \sum_{i=1}^{9} \beta_{i,n} * R_{i,t} + \varepsilon_t \ ; \\
\sum_{i=1}^{9} \beta_{i,n} &= 1, \ \beta_{i,n} \geq 0 \forall_i. \qquad (2)
\end{aligned}
$$

where

$R_{FoF,t}$: the fund of funds index return for month t (or the return of the representative fund of funds for month t)

$\beta_{i,n}$: estimated exposure of funds of funds to style i for n^{th} time window.

$R_{i,t}$: index return of style i for month t.

The first constraint is necessary since hedge funds styles are the only assets in the portfolio of the representative fund of funds and hence the total exposure of the portfolio to the hedge fund styles should be unity. The second (non-negativity) constraint arises because funds of funds can not take short positions in hedge funds. We repeat the same regression each time we roll the window forwards, with the new data points that lie in the new window and hence obtain a time series of style exposures (β's) for a total of 103 time windows between January 1994 and June 2004. As another point of interest is to find out differences between live and dead funds of funds, we estimate a different set of exposures for live and dead funds of funds using the respective representative fund of funds returns on the left hand side of the equation, without changing the independent variables.

3.2 Due Diligence Score

Recent studies in hedge funds point out the importance of due diligence. For instance, Brown, Fraser and Liang (2008) document that operational risk plays an important part in fund failure and due diligence serves as a

protective measure by reducing the operational risk. Following this, one can reasonably assume that funds of funds pay attention to the due diligence quality of hedge funds when they are investing in them. We therefore would like to uncover whether the style exposures of funds of funds are driven by average due diligence quality within styles.

As there is no widely accepted measure to quantify due diligence, we try to find a proxy to rate the due diligence of hedge funds. Brown, Fraser and Liang (2008) relate the due diligence quality to the popularity of service provider companies funds work with. Moving from this finding, we construct a due diligence measure depending on the number of different hedge funds that work with the same company.

The data set includes company information about ten types of services, namely administrator, auditor, bank, custodian investment advisor, legal council, management firm, prime broker, sponsor/general partner and underwriter. We start by assigning a recognition score to each company, which is simply one less the number of different funds that obtain services from the company. While doing so, we consolidate all subsidiaries, divisions and different spellings of companies under one. For example, there is a single recognition score for the forty six subsidiaries of Bear Stearns (including Bear Stearns UK, Bear Stearns US/NY, Bear Stearns US/IL, Bear Stearns Bahamas). Another point that needs clarification is that the recognition scores are not service-specific. That is, if a company provides more than one type of service, it still gets one score, which is one less the number of all hedge funds that hire them, but not a different score for each type of service. We find it useful to emphasize that we make sure a fund is not counted multiple times even if it receives more than one type of service from a company.

In the next step we construct the due diligence score for each hedge fund for which we have the company information for at least one type of service, as the sum of the recognition scores of all companies the fund receives services

from. To convert this static variable into a pseudo-time series, we find the funds that are alive during each time window, and calculate the due diligence index of styles as the average due diligence score of all funds that adopt the same style and are alive during the time window of interest. To illustrate how due diligence scores differ across hedge fund styles and change throughout the sample period, we plot the time series of due diligence scores of all styles in Figure 2.

4 Analysis

4.1 Drivers of Exposure Shifts

After completing the preliminary work, we move on to the second part of the analysis, in which we investigate whether funds of funds change their style exposures depending on the past returns on the eight risk factors defined by Fung and Hsieh (2004), style performances and average due diligence scores of styles.

We first examine the effects of risk factors and due diligence on changes in style exposures of hedge funds. As the risk factors are not style-specific, we run a separate OLS regression for the set of exposures to each style instead of a pooled or panel regression. For each of the nine sets of exposures we estimate the following equation:

$$\beta_{i,n} = \alpha_i + \gamma_i' RF_{n-1} + \delta_i DD_{i,n-1} + \nu_{i,n} \tag{3}$$

where

$\beta_{i,n}$: the estimated exposure to style i for time window n

RF_{n-1} : the 8x1 vector of risk factor returns for n-1$^{\text{th}}$ time window

$DD_{i,n-1}$: due diligence score of style i for n-1$^{\text{th}}$ window

$\nu_{i,n}$: error term

While the first eight regressors are common in all regressions, the ninth regressor in each is the past due diligence performance of the corresponding style. To uncover the differences between live and dead funds of funds, we repeat the same exercise with the exposures estimated for live and dead subsamples.

In a second type of analysis we look into the effect of past style performances on the changes in style exposures of funds of funds. As performance measure we use the returns of the style indexes, the growth in net asset value of the funds within styles and the Sharpe ratios of style indexes calculated as the average return per standard deviation. fSince style performances are style-specific unlike the risk factor returns, we do not need to run separate regressions for the exposures to each style. Instead, we estimate the effects of style performances and due diligence through the following random effects panel regression equation:

$$\beta_{i,n} = \alpha + \lambda_R R_{i,n-1} + \lambda_{SR} SR_{i,n-1} + \lambda_{NAV} NAV_{i,n-1} + \eta_{i,n} \qquad (4)$$

where

$R_{i,n-1}$: index return of style i for time window n-1

$SR_{i,n-1}$: Sharpe ratio of the index of style i for time window n-1

$NAV_{i,n-1}$: growth of net asset value of style i for time window n-1

$\eta_{i,n}$: the combination of individual random effects and random error

Notice that the intercept and regression coefficients are not style-specific (α and λ's are not indexed with i) in this equation. This means the effects of the regressors estimated in this regression apply to the shifts in style exposures of funds of funds in general, but not specifically to one style as in the previous analysis. This second analysis is particularly useful in that it enables us to estimate the overall effect of due diligence on the shifts in

style exposure, instead of its effect on exposure to each style separately, and hence reach a more general conclusion about its effect. As the previous one, we repeat this exercise for one-year lags and the exposures of live and dead funds of funds.

4.2 Style Diversification Performance of Funds of Funds

Another question we would like to address in this paper is whether funds of funds provide sufficient style diversification. One possible approach to find this out would be to calculate the return and variance of the portfolio implied by the estimated exposures, then construct the portfolio that yields the same return but has the minimum variance for the same period and compare the two. However, as the fund managers do not know the returns ex-ante and the minimum variance portfolio is constructed ex-post, that is, after the returns and variances are realized, this would be an unfair game. Instead, we take a naive indexing strategy, which is simply investing in a value-weighted average of hedge funds as benchmark and compare the Sharpe ratios of the exposure-implied portfolio and the index portfolio. To capture the differences in diversification performance between live and dead funds, we also include the portfolios implied by the estimated exposures for live and dead funds in the comparison.

5 Results

5.1 Style Exposures

The estimated exposures for each of the nine styles are depicted in Figure 3 a-i. At a first glance the figures reveal that managed futures is the only style that gets nonzero exposures for all, live and dead funds of funds, in all time windows. The exposures to dedicated short bias style, on the other

hand, is zero for a majority of the frames, especially for dead funds of funds. One other interesting observation is that dead funds of funds have zero exposure to certain styles in more frames than do live funds of funds; suggesting on average live funds of funds invest in more styles than do dead funds of funds, and hold a more diversified portfolio. In line with this, one should also observe dead funds of funds take more extreme positions in styles when compared to live funds of funds (i.e. when both dead and live funds of funds get nonzero exposure to a certain style within a time window, the magnitude of the exposure is usually larger for dead funds of funds). When it comes to trends in exposures, it is not possible to speak of a consistent trend towards or away from one style, except for the decreasing pattern observed in the exposure to managed futures style for all groups of funds of funds.

5.2 Risk Factors, Due Diligence and Style Exposure Shifts

The first analysis is geared towards finding out whether funds of funds shift their style exposures based on the previous values of eight risk factors inherent in hedge funds and due diligence quality of hedge fund styles. We estimate a separate regression equation for each style, using one window lagged values of risk factor returns and the due diligence score of the corresponfind style as the independent variables. We repeat the regressions for the estimated exposures of live and dead funds of funds.

Tables 3 through 5 report the results of the regressions. Although the R-squared values vary depending on the style and the sample for which we perform the regression, the lagged risk factors and due diligence scores manage to explain as high as 96.44% of the variation in style exposures. Notice that although we have 103 observations for each dependent variable (since we estimate the exposure of funds of funds to each style for 103 time windows) there are only 79 observations in the regressions. This is because the

time series of the three trend following factors are available as of January 1994, and hence to regress exposures on one window-lagged risk factors we need to discard the 24 exposures of the windows that begin before January 1996. Another point that needs attention is the different order of magnitude of risk factors and the due diligence scores. The values of risk factors are the percentage returns. Hence the coefficient estimated for a risk factor indicates how many percentage points funds of funds will change (increase if the coefficient has positive sign, decrease if negative) their exposure to the style on average, when the risk factor is one percentage point higher, provided that all other risk factors and the due diligence score remains constant. On the other hand, as can be seen in Figure 2, the due diligence scores range between roughly 950 and 1900. The coefficients estimated for the due diligence scores show how much on average the style exposure of funds of funds would change in response to an increase of due diligence score by one and risk factors remain unchanged.

Regression results suggest risk factors have different effects on the shifts in exposures to different styles. The difference comes in multiple forms; in significance levels, signs and magnitudes of the coefficients. For example, looking at Table 3 we observe that, when all other variables remain unchanged but the S&P500 return (SP500) goes up by one percent during the preceding time window, funds of funds are expected to increase their exposure to event driven style by 9.5%, the exposure to global macro by 3.13% and hence adhere to a trend-following strategy but decrease the exposure to fixed income arbitrage by 19.7%. At the same time, SP500 has no significant effects on the style exposures to emerging markets or convertible arbitrage styles, therefore funds of funds should not be expected to shift their exposures to these styles in response to such an increase in SP500. Exposure to global macro style shows sensitivity to all market risk factors and trend following factors in exchange rate (TFFX) and commodities (TFCOM). This is an expected result, since global macro funds in simplest terms bet on macro-

economic events around the globe, which affect all market segments as well as exchange rates and commodity prices. Therefore funds of funds should pay note to market-related risk factors as well as interest rate and currency-related ones. Exposure to equity market neutral style is not significantly affected by the S&P500 index. This is another expected result, as equity market neutral funds follow a market-neutral strategy in stocks. Exposure to event driven funds shows sensitivity to four risk factors in the same direction as global macro exposures, suggesting that funds of funds tend to change their exposures to event driven and global macro styles together. Another interesting finding is that funds of funds pursue a somewhat reverse strategy while changing their exposures to certain styles. What we mean here is, they shift their exposures to some styles according to the same risk factors, but in different directions. At the extreme, the exposures to emerging markets and equity market neutral styles show sensitivity to the same set of risk factors, but all coefficients get opposite signs for the two.

Another conclusion to infer from the results in Tables 3-5 is that due diligence does have an effect on the shifts in style exposures, but not necessarily for all styles. The exposures of all funds of funds to six (convertible arbitrage, dedicated short bias, equity market neutral, event driven, fixed income arbitrage, managed futures) out of nine styles show sensitivity to due diligence of the corresponding styles during the previous time window. When we repeat the same analysis with exposures for live and dead fund of funds subsamples, due diligence scores get positive significant coefficients for five out of nine styles (for live funds of funds due diligence of fixed income arbitrage loses significance, while for dead funds of funds due diligence of dedicated short bias becomes insignificant). All the significant coefficients have positive sign, which indicates funds of funds appreciate better due diligence and move their funds to those styles with better due diligence.

The difference between live and dead funds shows itself in more variables

than just due diligence. A comparison of Tables 4 and 5 quickly reveals major differences in the ways live and dead funds behave when it comes to determining the style mix of their portfolios. Tables suggest live and dead funds of funds base the shifts in their portfolio exposures on different factors, and even when the same factors affect the shifts in the exposures to the same style, magnitude and direction of the effect may differ. Live funds of funds behave in a very similar way to average funds of funds when changing their exposures to certain styles. For instance, the same set of risk factors get significant coefficients in the regressions with convertible arbitrage and fixed income arbitrage exposures for the exposures of entire sample and live subsample as can be seen in Tables 3 and 4. The signs of the exposures are the same and they are of comparable magnitude, which support the conclusion.

In a nutshell, this first analysis leads us to the conclusion that funds of funds do pay attention to the past performance of risk factors and the average due diligence quality of funds within styles when they change their style exposures, but this doesn't necessarily happen in a trend-following manner, since negative regression coefficients suggest funds of funds may respond to increases in the performance of certain risk factors by decreasing their exposures to some styles.

5.3 Style Performance, Due Diligence and Style Exposure Shifts

In this second analysis, we aim to find out the effects of previous style performance and average due diligence quality of styles on the changes in style exposures of funds of funds. Since we estimate coefficients through a random effects panel regression, they are not style-specific this time, and it is possible to draw general conclusions about exposure shifts, rather than style-specific conclusions.

Table 6 displays the results of the regressions. Similar to the first type of analysis, there is a difference between the orders of magnitude of performance measures and due diligence scores. Results show that growth in net asset value in the prior period is the most effective determinant of the style exposures of funds of funds, since the coefficient of net asset value growth has the highest magnitude regardless of the (sub)sample. The positive sign of the coefficients of net asset value growth indicates a higher net asset value growth of a style prompts funds of funds to invest more in that style. As net asset value growth is a combination of return and capital flows, this indicates both a trend chasing and herding behavior in funds of funds. That is, funds of funds tend to invest in hedge fund styles that yielded high returns and attracted more investments in the past. Sharpe ratio, on the other hand has an opposite effect, as it gets significant negative coefficients in all regressions, although much smaller in magnitude than the net asset value growth coefficient. This can be interpreted as funds of funds predict reversals in risk-adjusted performance of hedge funds. Rate of return has the smallest effect among all three performance measures, and is even insignificant in style shifts of live funds when the preceding window's returns are used. The coefficients estimated for the due diligence are highest for the exposures of dead funds of funds, and is not significant for live fund of funds exposures. This may be because live funds carry out the due diligence themselves; that is, hire third party companies to monitor funds they invest in or consider investing in, and therefore do not feel the need for any measures to proxy the due diligence quality of the funds and styles. This result is in line with Brown, Fraser and Liang (2008), who document that funds of funds that can afford better due diligence outperform others.

5.4 Style Diversification Performance of Funds of Funds

To assess the style diversification performance of funds of funds, we construct the portfolio implied by the exposures estimated for each style, then compare the Sharpe ratio of this portfolio to that of a naive indexing portfolio. To find out whether differences exist in performances of live and dead funds of funds, we also construct the portfolios implied by the exposures estimated for live and dead funds of funds, and compare them to each other and the index portfolio.

We plot the Sharpe ratios of the index portfolio and the portfolios constructed using the exposures for all, live and dead funds in Figure 4. Obviously, the portfolio of live funds of funds had higher Sharpe ratios than the portfolio of dead funds of funds. In fact, the Sharpe ratio of live funds of funds' portfolio is higher than the Sharpe ratio of dead funds of funds' portfolio in all 103 time windows. This finding supports the view of Liang (2000) that poor performance is the main cause of fund failure.

A comparison between the three implied portfolios and the index portfolio results in favor of funds of funds. All funds of funds portfolio attains a higher Sharpe ratio than the index portfolio in 64 out of 103 time windows. Live funds of funds do even better by beating the index portfolio in 73 windows. The figures imply the success of funds of funds is consistent. All funds of funds portfolio outperforms the index portfolio consistently in the last 60 time windows, while live funds of funds do even better by starting to consistently outperform the index earlier and have a higher Sharpe ratio than the index portfolio in the last 63 consecutive time windows. Dead funds of funds, on the other hand show a poor performance as the Sharpe ratio of dead funds of funds portfolio is higher than that of index portfolio in only 23 time windows.

6 Conclusion

In this paper we aim to take a step towards understanding the investment strategies of funds of funds by uncovering how they shift their style exposures and whether they provide sufficient style diversification. We propose that prior performances of hedge fund risk factors, style performances and average due diligence quality of the styles are amongst the drivers of changes in the exposures of funds of funds to different hedge fund styles. The results of our analyses are in support of this, as risk factors and due diligence scores manage to explain up to 96.44% of the variation in exposures. We document that risk factors, style performances and due diligence are effective in determining the direction and magnitude of the changes in style exposures of funds of funds. This effects come in the forms of trend following, herding and reversal prediction. The results imply funds of funds recognize the importance of due diligence, as due diligence performance gets positive significant coefficients, which means better due diligence is rewarded by more funds invested in the style by funds of funds. We also report that live and dead funds base their decisions on different factors and exhibit different behaviors while shifting their style exposures.

When assessing the style diversification performance of funds of funds, we find that they consistently outperform a naive indexing strategy. Live funds perform even better, since they outperform the index for more time windows and in a longer streak. Dead funds, on the other hand show a poor performance since they underperform the index portfolio almost 80% of the time.

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Table 1
Distribution of funds into styles

Style	Live	Dead	Total
Fund of Funds	807	302	1109
Convertible Arbitrage	132	56	188
Dedicated Short Bias	17	16	33
Emerging Markets	138	139	277
Equity Market Neutral	182	107	289
Event Driven	273	130	403
Fixed Income Arbitrage	121	73	194
Global Macro	134	129	263
Long/Short Equity Hedge	983	595	1578
Managed Futures	211	330	541
TOTAL	2998	1877	4875

Table 2
Summary statistics of the funds in the data set

Maximum and minimum refer to the highest and lowest return or net asset value reported during the sample period by any fund within the respective group. Averages are the arithmetic averages over time and individual funds in each group. Fund life indicates the number of months in which a fund reported between January 1992 and June 2004.

	Rate of Return (Monthly, %)				Average Sharpe Ratio	Net Asset Value			Average Fund Life
	Average	Maximum	Minimum	Avg. Stdev.	(Mean/Stdev.)	Average	Maximum	Minimum	(Months)
Fund of Funds	0.70	71.87	-94.83	2.26	0.39	2,567.53	1,123,827.71	0.77	52.68
Convertible Arbitrage	0.97	38.73	-45.00	1.83	0.68	1,563.76	54,330.15	2.08	59.00
Dedicated Short Bias	0.20	66.01	-57.40	7.12	0.02	1,105.68	9,181.80	22.21	78.36
Emerging Markets	1.32	137.46	-85.49	7.23	0.24	1,313.98	167,817.91	0.55	62.43
Equity Market Neutral	0.84	151.74	-24.39	2.51	0.30	1,130.44	33,373.16	0.97	41.91
Event Driven	1.14	184.17	-40.49	2.61	0.56	4,103.68	408,069.36	0.99	59.75
Fixed Income Arbitrage	0.81	44.25	-55.72	2.24	0.78	11,794.73	586,448.94	0.76	49.83
Global Macro	0.80	87.33	-50.00	4.69	0.21	1,832.55	95,738.19	1.13	50.78
Long/Short Equity Hedge	1.37	122.46	-78.01	5.07	0.29	2,306.96	591,024.58	0.70	53.27
Managed Futures	0.76	298.12	-94.03	5.64	0.09	2,787.85	144,786.39	0.39	58.38
All Funds (excl. FoF's)	1.05	298.12	-94.03	4.52	0.32	2,752.15	591,024.58	0.39	54.84
Live Funds (excl. FoF's)	1.27	167.42	-73.25	3.73	0.44	3,010.22	591,024.58	0.39	59.28
Dead Funds (excl. FoF's)	0.73	298.12	-94.03	5.63	0.16	2,185.37	328,068.77	0.85	48.66

Table 3
Effects of past risk factor performances and due diligence scores on exposures for entire sample

Standard errors are reported in parentheses. *, ** and *** represent significance at 10, 5 and 1% level, respectively.

	CA	DSB	EM	EMN	ED	FIA	GM	LSEH	MF
smb	2.9289	-0.4240	-0.5955	0.8124	-1.6809	-1.6561	-0.0891	0.8908	-0.5663
	(2.5375)	(0.4944)	(0.9963)	(2.0629)	(4.0588)	(2.3325)	(2.3709)	(2.0791)	(2.6535)
sp500	1.7370	0.3241	1.3399	0.8030	9.5012***	-19.6946***	3.1290***	6.6025***	6.4923***
	(1.6913)	(0.3829)	(1.0543)	(0.8885)	(3.2116)	(1.4753)	(1.0097)	(2.4167)	(1.9776)
tbill	10.2900***	-0.1171	-3.1883***	6.6853***	-19.1125***	-1.2049	-4.0491*	3.9305*	-1.4514
	(3.1763)	(0.4600)	(1.0799)	(1.3178)	(4.1185)	(2.2495)	(2.0704)	(1.9756)	(2.1956)
spread	5.1236***	0.1868	-1.1826**	2.7735***	-12.0108***	4.9823***	-5.4567***	0.2290	-1.6555
	(1.8601)	(0.2260)	(0.5153)	(0.7206)	(2.6305)	(1.2325)	(1.1465)	(1.5499)	(1.1667)
tfbond	0.1643	-0.0604	0.4231**	-0.8045***	1.7931*	-1.6236***	0.4092	1.0469**	0.6669
	(0.6044)	(0.0735)	(0.1754)	(0.2808)	(1.0590)	(0.4030)	(0.4296)	(0.4901)	(0.4344)
tffx	1.5481**	-0.1988**	-0.7782***	0.4313*	-2.8517***	1.5627***	2.0965***	-0.0687	-1.9158***
	(0.6509)	(0.0922)	(0.2587)	(0.2275)	(0.7703)	(0.4712)	(0.3805)	(0.5150)	(0.4359)
tfcom	3.6339***	-0.0677	0.0159	-0.3002	-1.7236**	-0.2194	-1.6923***	-0.9200	-1.5866***
	(0.7315)	(0.1057)	(0.2081)	(0.2597)	(0.8301)	(0.8165)	(0.4593)	(0.5250)	(0.4066)
msciret	-0.2738***	-0.0265**	0.0653*	-0.0694**	0.1479	0.1985***	0.0501	-0.2115***	0.0191
	(0.0848)	(0.0119)	(0.0370)	(0.0325)	(0.1155)	(0.0614)	(0.0456)	(0.0501)	(0.0654)
cadd	0.00093***								
	(0.00034)								
dsbdd		0.00019***							
		(0.00005)							
emdd			0.00007						
			(0.00025)						
emndd				0.00011*					
				(0.00007)					
eddd					0.00393***				
					(0.00071)				
fiadd						0.00046**			
						(0.00023)			
gmdd							-0.00008		
							(0.00037)		
lsehdd								-0.00022	
								(0.00062)	
mfdd									0.00142**
									(0.00059)
_cons	-1.3702***	-0.2899***	-0.1232	-0.1336	-5.8508***	-0.2772	0.2189	0.3422	-1.4087**
	(0.5463)	(0.0778)	(0.4541)	(0.1002)	(1.0877)	(0.3481)	(0.4993)	(0.9325)	(0.6231)
# Obs.	79	79	79	79	79	79	79	79	79
R-Squared	0.8273	0.6346	0.5803	0.5735	0.5279	0.9644	0.6500	0.5585	0.8196
F(9, 69)	60.26***	11.25***	19.61***	11.47***	15.7***	247.3***	18.4***	26.32***	43.38***

Table 4
Effects of past risk factor performances and due diligence scores on exposures for live subsample

Standard errors are reported in parentheses. *, ** and *** represent significance at 10, 5 and 1% level, respectively.

	LIVECA	LIVEDSB	LIVEEM	LIVEEMN	LIVEED	LIVEFIA	LIVEGM	LIVELSEH	LIVEMF
smb	2.4092	-0.3298	-0.1137	2.3882	-3.2269	-2.4351	1.4879	1.0008	-0.9510
	(2.9631)	(0.4733)	(1.0178)	(2.2154)	(4.0006)	(2.7041)	(2.4512)	(1.9244)	(2.2430)
sp500	2.6950	0.2262	1.2616	4.6442***	6.6251*	-21.6357***	8.0362***	6.1972***	3.6926**
	(1.8020)	(0.3446)	(0.9012)	(1.0451)	(3.3429)	(1.5429)	(0.9742)	(2.2060)	(1.6055)
tbill	13.0790***	0.1952	-2.1993**	6.4121***	-22.5159***	-4.0223	-2.0795	4.0078**	-1.1241
	(3.1925)	(0.4786)	(0.9043)	(1.4387)	(4.4173)	(2.5468)	(1.8323)	(1.8093)	(1.8248)
spread	6.7289***	0.2243	-0.7132	1.6117*	-13.9400***	3.9428***	-4.7822***	0.2246	-0.7235
	(1.9617)	(0.2406)	(0.4454)	(0.9661)	(2.7781)	(1.3596)	(1.1190)	(1.4236)	(0.9917)
tfbond	0.6719	-0.1079	0.4642**	-0.3172	2.2527**	-1.8876***	-0.1278	0.6373	0.4962
	(0.6775)	(0.0763)	(0.1596)	(0.3542)	(1.0876)	(0.4473)	(0.4175)	(0.4393)	(0.3845)
tffx	1.3822**	-0.1023	-0.7455***	0.0410	-2.0388**	1.5229***	1.4588***	-0.2717	-1.5482***
	(0.6732)	(0.0927)	(0.2240)	(0.2681)	(0.8232)	(0.5234)	(0.4262)	(0.4635)	(0.3547)
tfcom	3.2449***	-0.0815	0.0169	-0.0606	-1.4143*	0.3503	-3.0649***	-1.0096**	-0.6858*
	(0.7498)	(0.0967)	(0.1836)	(0.3386)	(0.8491)	(0.8167)	(0.5261)	(0.4596)	(0.3644)
msciret	-0.2787***	-0.0350***	0.0330	-0.1895***	0.2603**	0.2800***	-0.0259	-0.2134***	0.0587
	(0.0812)	(0.0123)	(0.0310)	(0.0328)	(0.1228)	(0.0687)	(0.0454)	(0.0466)	(0.0542)
cadd	0.0008**								
	(0.00036)								
dsbdd		0.00016***							
		(0.00004)							
emdd			0.00028						
			(0.00021)						
emndd				0.00035***					
				(0.00008)					
eddd					0.00371***				
					(0.00073)				
fiadd						0.00023			
						(0.00022)			
gmdd							-0.00037		
							(0.00044)		
lsehdd								-0.00033	
								(0.00056)	
mfdd									0.0010**
									(0.00050)
_cons	-1.1767**	-0.24236***	-0.5045	-0.4646***	-5.4864***	0.0733	0.5771	0.4979	-0.9661*
	(0.5702)	(0.0662)	(0.3846)	(0.1223)	(1.1258)	(0.3386)	(0.5991)	(0.8451)	(0.5212)
# Obs.	79	79	79	79	79	79	79	79	79
R-Squared	0.8133	0.6209	0.6994	0.6828	0.5183	0.9592	0.7639	0.5666	0.7429
F(9, 69)	53.74***	10.99***	37.83***	25.17***	14.05***	200.46***	26.96***	25.11***	27.85***

Table 5
Effects of past risk factor performances and due diligence scores on exposures for dead subsample

Standard errors are reported in parentheses. *, ** and *** represent significance at 10, 5 and 1% level, respectively.

	DEADCA	DEADDSB	DEADEM	DEADEMN	DEADED	DEADFIA	DEADGM	DEADLSEH	DEADMF
smb	0.1016	-0.0439	-1.8153	1.1565	-2.9302	0.5688	-2.4063	3.4570	-1.0760
	(2.5114)	(0.0622)	(2.3677)	(2.2173)	(4.0043)	(2.8096)	(2.7195)	(2.9079)	(3.8776)
sp500	-4.0772***	-0.0252	2.2281*	2.1947	0.6009	-10.3178***	-2.2289**	13.9343***	14.4489***
	(1.1806)	(0.0220)	(1.3326)	(1.6500)	(3.6303)	(1.4213)	(1.0575)	(2.7589)	(3.1106)
tbill	0.5356	-0.0500	-2.1709	6.4350***	-17.0657***	-2.6131	-4.7982	9.5742***	-0.5362
	(2.0367)	(0.0532)	(1.4111)	(2.1525)	(4.5559)	(3.2182)	(2.8874)	(2.9728)	(3.0874)
spread	-4.4886***	-0.0190	-0.9320	3.7031***	-6.7464**	3.7763***	-5.1589***	1.7406	-2.9352*
	(1.6339)	(0.0357)	(0.7677)	(1.2866)	(2.9365)	(1.4149)	(1.2968)	(2.1135)	(1.6217)
tfbond	-0.0036	-0.0026	1.3504***	-2.0197***	-0.4508	0.9007	0.3961	0.8438	1.8648***
	(0.3735)	(0.0076)	(0.2957)	(0.5451)	(1.1374)	(0.5502)	(0.4274)	(0.7035)	(0.5935)
tffx	0.3354	0.0031	-1.3567***	1.3047***	-1.2123	-0.7475	1.6383***	0.9049	-2.0944***
	(0.4555)	(0.0071)	(0.3157)	(0.3898)	(0.8486)	(0.5448)	(0.4549)	(0.6107)	(0.6239)
tfcom	1.9519***	0.0069	0.6617**	-1.2225**	-2.0357**	-0.9995	0.4962	-1.7874***	-2.6367***
	(0.5329)	(0.0066)	(0.2625)	(0.5121)	(0.8406)	(0.7920)	(0.5130)	(0.5814)	(0.5425)
msciret	-0.0284	0.0018	0.0466	0.0195	0.2398**	-0.0812	0.1134*	-0.2570***	-0.1053
	(0.0722)	(0.0015)	(0.0562)	(0.0450)	(0.1066)	(0.0662)	(0.0669)	(0.0652)	(0.0932)
cadd	0.00042*								
	(0.00024)								
dsbdd		0.00000							
		(0.00000)							
emdd			-0.00007						
			(0.00031)						
emndd				0.00028**					
				(0.00012)					
eddd					0.00293***				
					(0.00081)				
fiadd						0.00137***			
						(0.00027)			
gmdd							-0.00028		
							(0.00052)		
lsehdd								0.00130	
								(0.00080)	
mfdd									0.00174*
									(0.00091)
_cons	-0.5415	0.0003	0.1530	-0.3853**	-4.2819***	-1.7076***	0.5056	-1.9294	-1.7662*
	(0.3764)	(0.0034)	(0.5503)	(0.1726)	(1.2571)	(0.4071)	(0.7148)	(1.2022)	(0.9529)
# Obs.	79	79	79	79	79	79	79	79	79
R-Squared	0.4301	0.0815	0.6555	0.6198	0.6772	0.8890	0.5261	0.5853	0.8735
F(9, 69)	3.01***	0.22	22.33***	7.42***	29.79***	89.12***	9.85***	11.33***	85.85***

Table 6
Effects of style performances & due diligence

Standard errors are reported in parantheses. *, ** and *** indicate significance at 10%, 5% and 1% level, respectively.

	ALL	LIVE	DEAD
ror-1w	0.0127*	-0.0014	0.0318***
	(0.0071)	(0.0066)	(0.0078)
sr-1w	-0.0519***	-0.0426***	-0.0498***
	(0.0104)	(0.0105)	(0.0105)
navg-1w	1.0224***	1.1386***	0.4802***
	(0.2064)	(0.2109)	(0.1755)
dd-1w	0.00007*	0.00004	0.00029***
	(0.00003)	(0.00003)	(0.00004)
_cons	0.0349	0.0727	-0.3168***
	(0.0625)	(0.0576)	(0.0753)
# Obs.	927	927	927
# Groups	9	9	9
R-sq. Within	0.0969	0.0985	0.0953
R-sq. Between	0.1300	0.2101	0.2819
R-sq. Overall	0.0045	0.0098	0.0404
Wald chi^2(5)	58.91***	50.52***	99.31***

Figure 1
The Evolution of Number of Hedge Funds and Funds of Funds
Solid line depicts the evolution of the number of hedge funds (excluding funds of funds), the dashed line the number of funds of funds.

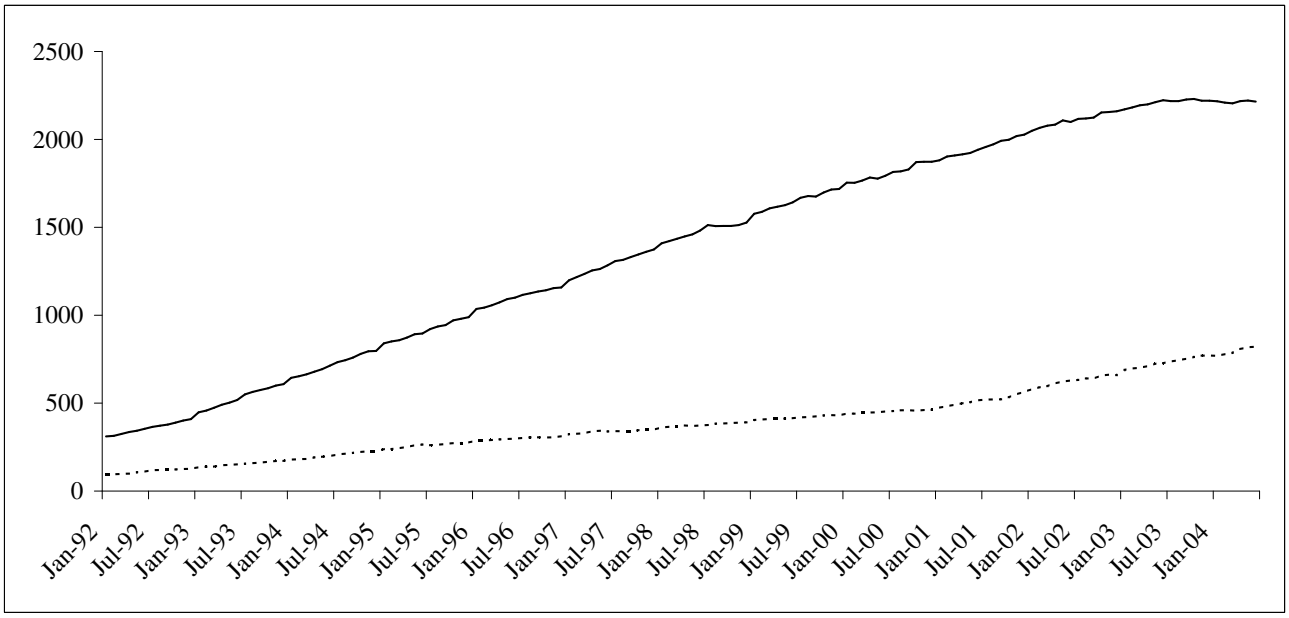


Figure 2
Due diligence scores of styles

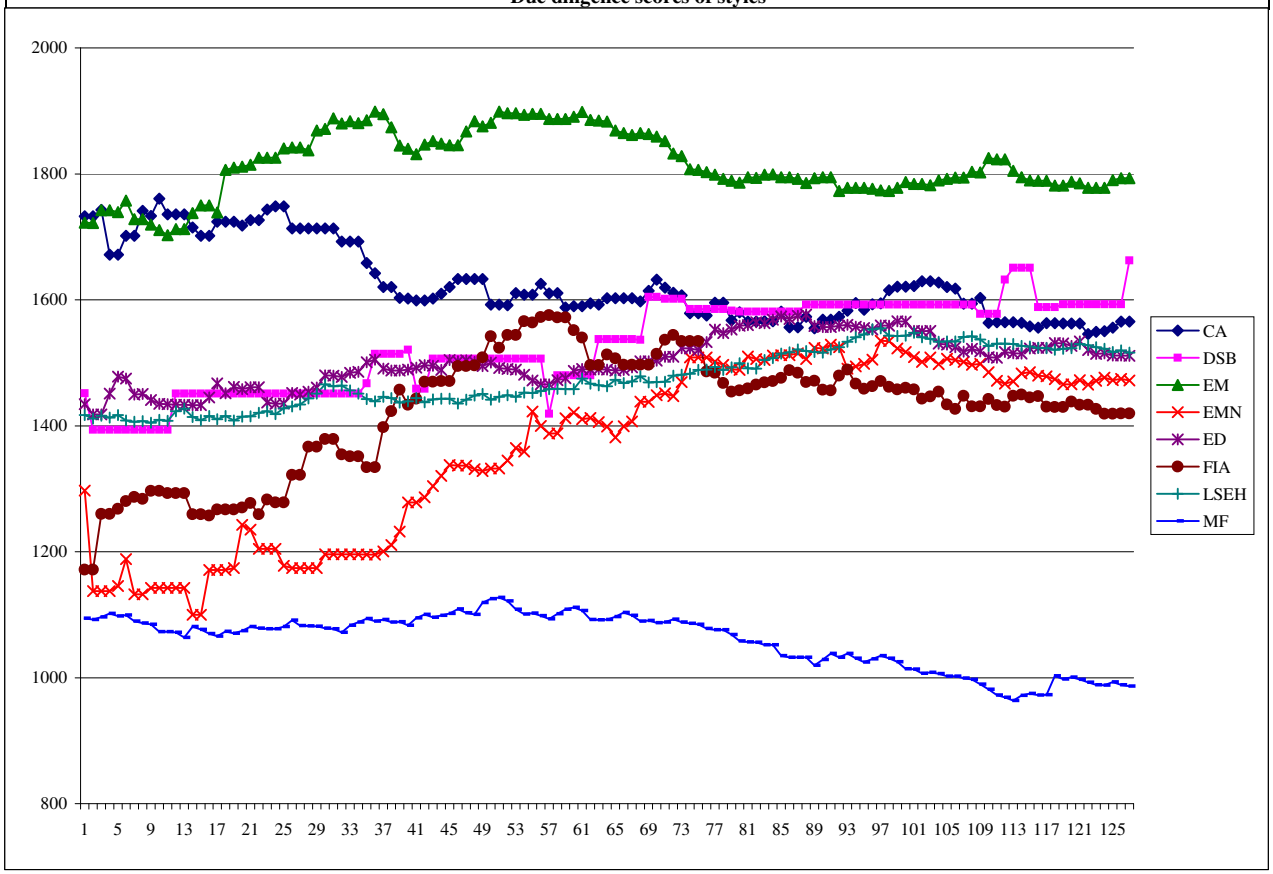
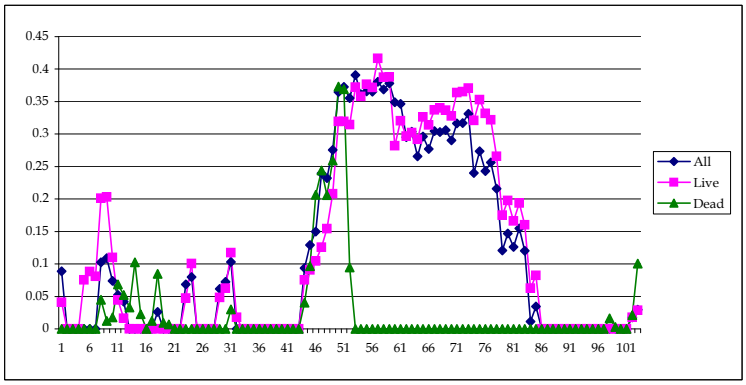
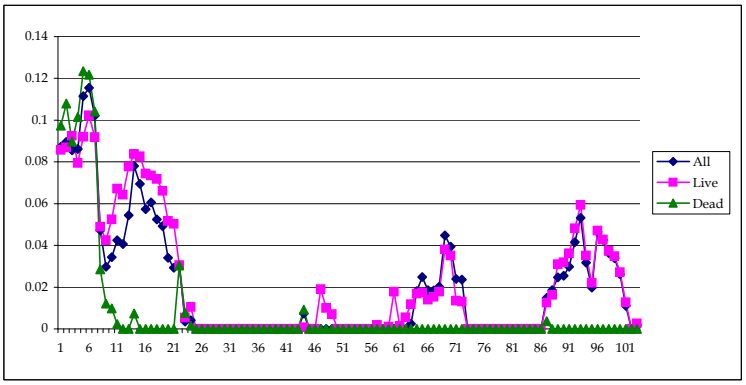


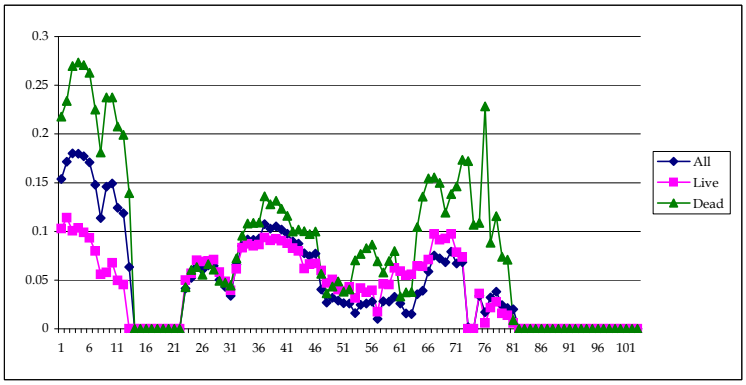
Figure 3
Style exposures estimated for the whole sample and live and dead subsamples



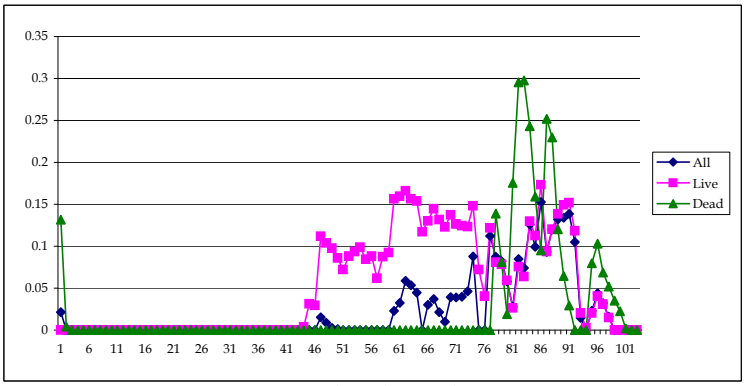
a) Convertible Arbitrage



b) Dedicated Short Bias

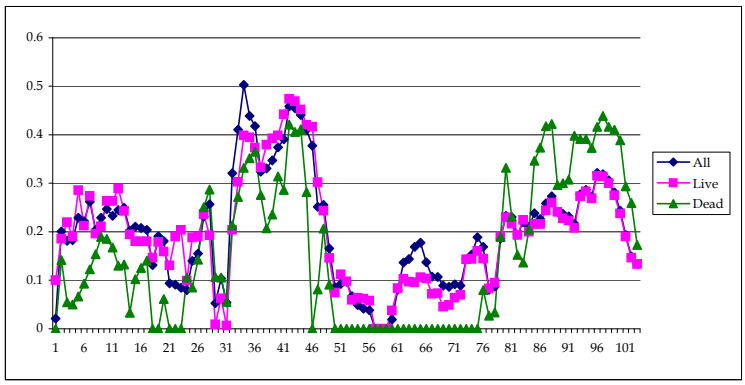


c) Emerging Markets

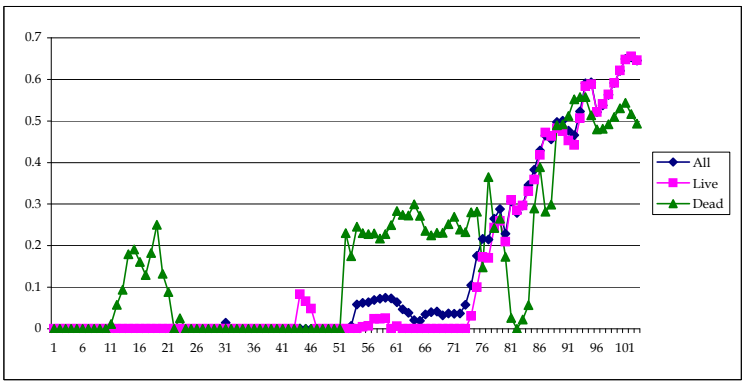


c) Equity Market Neutral

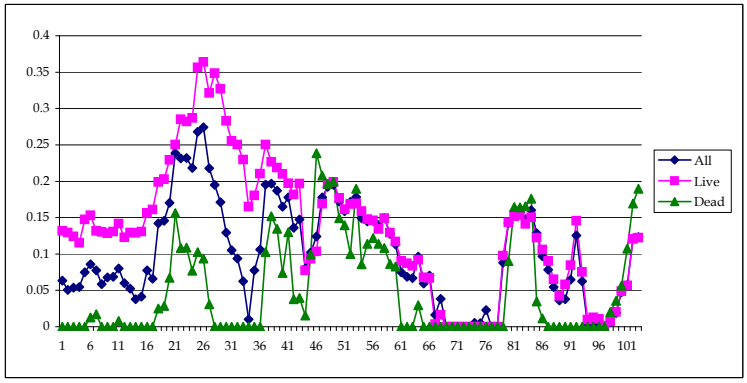
Figure 3 - Continued
Calculated and Tremont indices



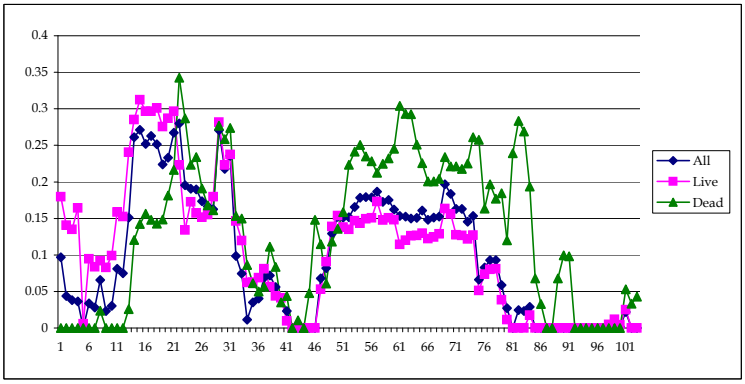
e) Event Driven



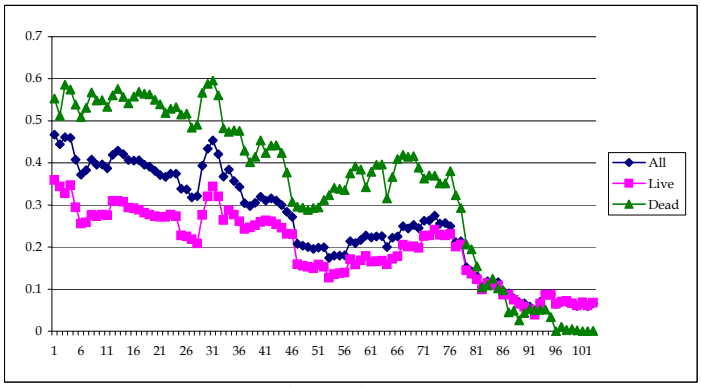
f) Fixed Income Arbitrage



g) Global Macro



h) Long/Short Equity Hedge



i) Managed Futures

Figure 4
The Sharpe Ratios of index portfolio and all, live and dead funds of funds portfolios